1958

A Recommended Program for High School General Mathematics as Determined by an Appraisal of Present Content and Placement of Subject Matter.

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A RECOMMENDED PROGRAM FOR HIGH SCHOOL GENERAL MATHEMATICS AS DETERMINED BY AN APPRAISAL OF PRESENT CONTENT AND PLACEMENT OF SUBJECT MATTER

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Education

by
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A.B., Southeastern Louisiana College, 1942
M.A., Louisiana State University, 1952
May, 1958

ACKNOWLEDGMENTS

The writer wishes to express appreciation to Dr. William A. Lawrence and other members of her faculty advisory committee for helpful suggestions at the initiation of the study and prudent counsel in contingent developments that followed; to representatives of the various state departments of education whose early responses served to expedite subsequent phases of the study; to the several publishing companies for their cooperation in furnishing examination copies of the textbooks selected for analysis; to the members of the evaluating panel for their serious consideration for detail in rating the topics as to their importance and grade placement; to Mrs. Margaret S. Burch for valuable assistance in typing the original and final manuscripts; to members of the writer's immediate family whose forbearance in making demands on her time enabled completion of the study.

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ABSTRACT

The purpose of this study was to formulate a program for high school general mathematics on the basis of an appraisal of present content and placement of subject matter.

In the initial phase of the study the director of the proper division of the state department of education in each of the forty-eight states was sent a questionnaire relative to high school general mathematics courses and textbooks used in these courses. Of the forty-five state departments returning questionnaires, twenty-five reported titles, authors, and publishers of general mathematics textbooks on the state-adopted, state-approved, or state multiple listing of textbooks. From this list, twenty selected textbooks were analyzed according to number and percentage of pages devoted to various topics and a combined list of topics was made. The next step was concerned with the selection of the appraisal group to evaluate each topic in the combined list as to its importance and grade placement in a program of high school general mathematics. Mr. M. H. Ahrendt, Executive Secretary of the National Council of Teachers of Mathematics, together with the Board of Directors, was requested to recommend a panel of leaders in the field who, in their opinion, were competent to evaluate high school general mathematics courses. Each member of the appraisal group selected in the manner described was sent the combined list of topics and was

requested to rate each topic as to its importance in accordance with an enclosed rating scale and to indicate the high school year or years in which the topic should appear. On the basis of this appraisal the recommended program for high school general mathematics was formulated.

A topic was included in the recommended program for high school general mathematics if its mean rating was as high as 2.0 which was the point value assigned a topic of some importance; a topic was placed in the year or years in which a majority of the panel members agreed as to grade placement; other topics, on which there was not majority agreement, were included as supplementary material in the year or years in which the percentage of agreement was highest. When the program for each year was formulated, it was found that the number of topics included each year decreased sharply after the freshman year. It was therefore recommended that further study be made in order to determine (1) the allotment of time for general mathematics in each high school year and (2) the measures to be used in organizing and administering such a high school program of general mathematics.

CHAPTER I

THE PROBLEM AND PLAN OF PROCEDURE

> The study of mathematics is only for those who need it, those who can do it, and those who like it--Anon.

As early as 1827 the teaching of United States history, bookkeeping, algebra, geometry, and surveying was required by law in every high school in towns of 500 families or more in Massachusetts.[1]

Beginning in the 1890's a number of related factors combined to subject the requirements for high school students to serious scrutiny. With the elective system gaining in prominence, every requirement was questioned. With the great increase in high school enrollment came an increased demand for high school teachers. Since the teacher training curricula did not in general require mathematics, the "new teacher" began to question the appropriateness of any mathematics requirement at the high school level.[2]

At about the same time, such important men as President Eliot in the field of higher education began to raise questions regarding the

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[1] E. P. Cubberley, Public Education in the United States (New York: Houghton Mifflin Company, 1919), p. 193.

[2] C. C. Hurd, "Mathematics in General Education," Journal of General Education, 1: 45-51, October, 1946.

content of mathematics courses and the appropriateness of required mathematics in the curriculum.[3]

I. GROWTH OF THE GENERAL MATHEMATICS MOVEMENT AND THE SUBSEQUENT DEVELOPMENT OF THE PROBLEM OF ITS PLACE IN THE CURRICULUM

Historically, the first proposals for modifying the traditional sequence came notably from Professor E. H. Moore of the University of Chicago. In an address before the American Mathematical Society in 1902, Moore made his plea for a coherent four-year course and proposed that both the method and content of mathematics courses be enriched and made more vital and effective.[4]

Schorling,[5] some thirty years later, discussed six causes giving rise to the general mathematics movement:

(1) A new philosophy of secondary education was gaining acceptance. School men began to realize that materials in mathematics were geared too high for large groups of pupils and that many essentials of social importance were so long delayed that many pupils dropped out of school before they had an opportunity to profit by them. This led to

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[3]Cubberley, op. cit., pp. 455-456.

[4]Raleigh Schorling, The Teaching of Mathematics (Ann Arbor: The Ann Arbor Press, 1936), pp. 39-50.

[5]Ibid., pp. 53-56.

the convinction that the mathematics curriculum should be reorganized to meet the needs of such pupils.

(2) Dissatisfaction with the organization of high school mathematics was being widely expressed by teachers of college mathematics.

(3) The writings of leaders abroad were beginning to modify our thinking. In the latter part of the nineteenth century, John Perry in England was strongly emphasizing the practical side of mathematics and advocating less formal organization of the subject.

(4) At the University of Chicago a four-year course in correlated mathematics was being developed in response to Professor Moore's address.

(5) Textbooks for junior high school grades were appearing in which no year was devoted to a single subject. This was, in essence, an argument that it was more sensible to teach the various branches of mathematics in a way that would emphasize their natural interrelationships.

(6) T. Percy Nunn was attempting in England to psychologize the teaching of mathematics. Concerned with the organization of mathematics that contributed to the ease of learning rather than logical organization, Nunn was among the first mathematicians to exhibit a clear insight into the ways in which pupils master the introductory concepts of mathematics.

Factors giving impetus to the general mathematics movement

were enumerated in the First Yearbook of the National Council of Teachers of Mathematics as follows:

> (1) The population of our high schools has in the last quarter of a century been multiplied by more than ten whereas the population has not doubled. This increase in school population has given us a wider sampling of the general public and hence has in all probability lowered the level of ability. Certainly it has given us pupils with less background to do the conventional subjects successfully.
>
> (2) The number of children who should take one-year courses in mathematics is very large.
>
> (3) The investigation conducted by the National Committee on Mathematical Requirements. . . indicates clearly that what the college man or woman needs to know are precisely those elementary principles which a half dozen series of junior high school textbooks are striving to teach with great emphasis. . .
>
> (4) The rapid growth of the junior high school movement has given teachers a greater opportunity to teach worthwhile courses in seventh and eighth grades. . .
>
> (5) The large number of failures, together with the very low mastery on the part of pupils who pass the courses, makes it necessary that we organize the materials in the form in which they are more readily learned. . .
>
> (6) General mathematics facilitates motivation. . .[6]

From its inception the general mathematics movement represented an effort to get an additional course in the ninth year which

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[6]The National Council of Teachers of Mathematics, A General Survey of Progress in the Last Twenty-five Years (Washington, D. C.: The National Council of Teachers of Mathematics, 1926), pp. 102-104.

would more nearly meet the needs of pupils, particularly those of low ability and poor background and those who would leave school before graduating.

School administrators, charged with the responsibility of providing a suitable program of secondary education for those students whose needs, interests, and vocational plans were not served by college preparatory courses, recognized the need for a mathematics course to serve the following functions: (1) provide an opportunity to obtain a more complete mastery of fundamental concepts of mathematics for terminal students; (2) provide sufficient exploratory work in mathematics to enable the student still uncertain about his educational and vocational plans to make an intelligent choice concerning his study of mathematics; (3) provide the likelihood of being successful to less able students.[7]

The subject matter of this course should afford students opportunity to acquire greater facility in arithmetic, sufficient acquaintance with the basic concepts of algebra and geometry to carry on normal activities of business and industry, and an understanding of the elementary concepts of such courses as statistics and trigonometry.[8]

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[7]Claude H. Brown, The Teaching of Secondary Mathematics (New York: Harper and Brothers Publishers, 1953), p. 225.

[8]Ibid.

Indications are that organization and content of general mathematics courses are far from being crystallized and that there is much dissatisfaction with the program. The Twenty-Second Yearbook of the National Council of Teachers of Mathematics stated, "A growing body of mathematics educators felt that general mathematics had failed because it did not fill a real need in the pupil's life."[9] Further evidence of weakness of the program may be found in the criticisms of Boyce[10] and Betz[11] that general mathematics has turned out to be little more than a repackaging of an old product done up in small bundles.

There is some difference of opinion as to whether a one-year course in general mathematics is adequate to prepare the individual to deal with the quantitiative problems he will encounter in personal, family, and community affairs. There are leaders in curriculum development who believe that the logic of the situation points to a planned sequence in general mathematics.

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[9]The National Council of Teachers of Mathematics, Emerging Practices in Mathematics Education (Washington, D. C.: The National Council of Teachers of Mathematics, 1954), p. 290.

[10]G. A. Boyce and W. W. Beatty, "Six Issues in Secondary Mathematics," Clearing House, 11: 106, October, 1936.

[11]William Betz, "The Present Situation in Secondary Mathematics with Particular Reference to the New National Reports on the Place of Mathematics in Education," The Mathematics Teacher, 33: 343, December, 1940.

II. STATEMENT OF THE PROBLEM

The purpose of this study is to formulate a program for high school general mathematics as determined by an appraisal of present content and placement of subject matter. Steps in attainment of the purpose may be outlined as follows:

A. To determine the organization of the general mathematics program in high schools of the United States by means of a survey of mathematics courses offered in the forty-eight states as reported by the state departments of education

B. To determine the content of general mathematics courses as disclosed by an examination of selected state-adopted or state-approved textbooks of the various state departments of education

C. To obtain an evaluation of the content of general mathematics courses and the placement of subject matter

D. To formulate a proposed program for high school general mathematics on the basis of the evaluation

III. DELIMITATION OF THE PROBLEM

The survey for determining the organization of the general mathematics program and the content of the courses was limited to

the various state departments of education. No attempt was made to obtain a sampling of schools within the state. Any reference made to individual schools or to schools within a certain area of a state was made on the basis of information obtained from the state departments of education.

IV. DEFINITION OF THE TERM GENERAL MATHEMATICS

There has been some confusion of terminology in relation to general mathematics. As it originated, this course represented an effort to select the best from the different subjects in the field, to present it in such a way that pupils of average intelligence could understand it, and to place emphasis on correlation only to the extent that the correlation represented the natural relationships of the subjects.[12] This type of course may be designated by various titles--basic, introductory, consumer, exploratory, functional, or general mathematics.

Gager defined general mathematics as follows:

> Functional mathematics means that the basic mathematical concepts, principles, procedures, and skills for a particular course must be so thoroughly interwoven into the fabric of that course, and the materials are so carefully balanced between theory and socialized practices, that understanding, insight, and mastery of its applications will be a reality.[13]

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[12]The National Council of Teachers of Mathematics, The Training of Mathematics Teachers, Fourteenth Yearbook (New York: Bureau of Publications, Teachers College, Columbia University, 1939), p. 73.

[13]W. A. Gager, "Changing Mathematics Program," The National Education Association Journal, 40: 457, October, 1951.

Schorling defined general mathematics as:

> . . . an introductory, basic, exploratory course in which the simple and significant principles of arithmetic, algebra, intuitive geometry, statistics, and numerical trigonometry are taught so as to emphasize their natural and numerous interrelations.[14]

Elaborating on the definition given by Schorling, Brown indicated that general mathematics is a composite course which cuts across traditional subject matter boundaries and includes some material not ordinarily considered at the secondary level. Implementing the curriculum as a terminal rather than a preliminary course to more advanced work, general mathematics is designed to meet more adequately the needs of the large group of students who display little aptitude or liking for mathematics, or who plan to engage in educational or vocational pursuits which do not require extensive knowledge of mathematics.[15]

For the purpose of this study the term "general mathematics" will be used to designate a course which is so organized as to draw its materials from various mathematical subjects and which places emphasis on practical applications in order to insure mathematical competence for the ordinary affairs of life.

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[14]Schorling, op. cit., p. 52.

[15]Brown, op. cit., p. 223.

V. PLAN OF PROCEDURE

The director of the proper division of the state department of education in each of the forty-eight states was sent a questionnaire relative to general mathematics courses offered and textbooks used in these courses.[16] Accompanying the questionnaire was a letter of explanation. These data were used to determine the organization of the general mathematics program in the various states--that is, whether only a one-year course was offered or whether the program consisted of a planned sequence in general mathematics.

The second phase of the study dealt with the analysis of general mathematics textbooks currently used in the various states. Of the forty-five state departments returning questionnaires, twenty-five reported on general mathematics textbooks in use. The titles, authors, or publishers were taken from the state-adopted or state-approved list, or, in cases where there was no such adoption, from the multiple listing or list of state textbooks. The textbooks were analyzed according to number and percentage of pages devoted to various topics and a compiled list of topics was made.

The next step was concerned with the selection of the appraisal group to evaluate each topic on the compiled list as to its importance and grade placement. The writer requested M. H. Ahrendt, Executive

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[16]Appendix A.

Secretary to the National Council of Teachers of Mathematics, together with the Board of Directors, to recommend a panel of leaders in the field who, in their opinion, were competent to evaluate high school general mathematics courses.

Each member of the appraisal group selected in the manner described was sent a list of the compiled topics[17] and a letter explaining how each topic was to be rated as to its importance and its grade placement.

Finally, a proposed program for general mathematics at the high school level was developed on the basis of the appraisal made by the evaluating panel.

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[17]Appendix D.

CHAPTER II

REVIEW OF LITERATURE

I. OPINIONS OF LEADERS IN THE FIELD OF GENERAL MATHEMATICS

When the secondary schools came into existence, the courses in algebra and geometry then offered in the colleges were moved downward into the lower schools. These subjects, organized by college instructors for college students, were in no wise planned to meet the needs and abilities of high school pupils. At the turn of the century, when the history of general mathematics actually began, only a small percentage of young people attended high school. Formal mathematics of the day served a practical purpose since many pupils found use for it later in college.

Harl Douglass, one of the leaders in reconstructing the high school mathematics program, summarized the present-day situation as follows:

> Today when only one high-school freshman in ten will ever finish a year of college, and one high-school senior in five will ever enter college, the failure to offer mathematics other than algebra, geometry, and trigonometry is not defensible from the point of view of the pupil nor from that of the best interests of mathematics. Even the college-going student needs a much greater mastery of arithmetical processes--particularly ratio and proportion computation and operations with common and

> decimal fractions--as practically every professor of chemistry, physics, and engineering will testify.[1]

In outlining the content of the general mathematics program, Douglass advocated that the series of offerings for the great majority of pupils

> . . . should be composed largely of arithmetic and its applications to all phases of life, home, shop, farm, business, health, travel and transportation, social security, etc. It should also include considerable geometry of construction and measurement of surfaces and volumes. It should also include, correlated in its applications with arithmetic and geometry, at least six or seven months of algebra, literal and negative numbers, much work with simple equations and formulae; a large variety of applications particularly to science, considerable work with graphical representation, and some statistical constants and procedures.[2]

He further advocated that the program might take several forms:

> It might take the form of requiring a semester of mathematics and a semester of science each year thus assuring that the high school pupil does not dismiss mathematics from his mind. . . An alternate plan would involve a required year of general mathematics either in the ninth or tenth grade and again another required year either in the eleventh or twelfth grade.[3]

In a more recent work Douglass concluded that mathematics for

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[1]Harl R. Douglass, "Current Trends in the Secondary-School Mathematics Curriculum," Bulletin of the National Association of Secondary School Principals, 27: 19, February, 1943.

[2]Harl R. Douglass, "Mathematics for All," The Mathematics Teacher, 35: 214, May, 1942.

[3]Harl R. Douglass, "Mathematics for All and the Double-Track Plan," School Science and Mathematics, 45: 430, May, 1945.

general education should prepare the individual to deal with quantitative problems he will encounter in his personal, family, and community affairs. Since this cannot be done in one year, the logic of the situation points to a planned sequence in general mathematics designed to provide efficiency in dealing with personal and public problems of a quantitative nature.[4]

The following statement by Breslich indicates his agreement with Douglass on this point:

> It is evident that all this work cannot be crowded into the brief period of a one-year course. Some mathematical instruction will have to be a part of each year's work of the high school program.[5]

Breslich further indicated that the general mathematics course might be planned for one year, preferably the ninth grade, for five periods a week. The objection here is that after the ninth grade a large per cent of pupils will drop out of mathematics courses and before they are graduated much will have been forgotten because of disuse. To overcome this difficulty Breslich recommended two options: (1) allot two days a week for general mathematics for the ninth grade and two days for the tenth; (2) assign one period a week extending

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[4]Harl R. Douglass, ed., The High School Curriculum (New York: The Ronald Press, 1956), p. 472.

[5]E. R. Breslich, "New Mathematical Courses," California Journal of Secondary Education, 22: 461, December, 1947.

over the entire high school period.[6]

Betz also advocated that the general mathematics program be extended over a two-year period.

> Beginning in Grade 9 we should offer at least two different options: (1) a sequential course in academic mathematics, representing a sound foundation for professional work and (2) a two-year course in general mathematics for those who are interested in immediate life preparation.[7]

Chairman of the committee which planned the reorganization of high school mathematics for the war emergency in Indiana and member of the staff of Purdue University whose services are made available on full-time basis for conferring with high school mathematics teachers and administrators on the improvement of the teaching and the organization of mathematics, Walter Carnahan made the following statement:

> In general there are three types of pupils in high schools whose mathematical needs should be considered: (a) there are those whose interests are vocational (b) there are those whose interests are those of the consumer; (c) there are those whose interests are cultural or professional. . . For group (a) there should be a vocational mathematics sequence. For group (c) the traditional high school mathematics sequence is still the best that has been suggested. For group (b) there should be a sequence presenting elementary general mathematics and consumer mathematics.[8]

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[6]E. R. Breslich, "Curriculum Trends in High School Mathematics," The Mathematics Teacher, 41: 60, February, 1948.

[7]William Betz, "Five Decades of Mathematical Reform," The Mathematics Teacher, 43: 385, December, 1950.

[8]Walter H. Carnahan, "A Program for Improvement of High School Mathematics," School Science and Mathematics, 43: 762, November, 1943.

Accepting the aims according to the Report of the Harvard Committee, Fehr[9] emphasized the responsibility of the high school mathematics teacher in developing ability to think effectively, communicate thought, make relevant judgments, and discriminate among values in relation to quantitative thinking.

There are indications that leaders in the field of general mathematics consider a one-year course inadequate to insure mathematical competence to deal with quantitative problems and hence advocate a planned sequence in general mathematics.

II. REPORTS OF NATIONAL COMMITTEES

Since 1890 the mathematics program has been subjected to repeated scrutiny not only by individual reformers but also by committees representing various national organizations. The first comprehensive survey of the program of secondary education and its purpose in the United States was made by the Committee of Ten in 1893. Since it was assumed that mathematics had a general disciplinary value, this committee was freed from the necessity of critically examining the traditional content of courses or considering how this content could be helpful to young people in solving their problems. Its recommendations dealt

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[9] H. F. Fehr, "Proposals for a Modern Program in Mathematics Education in Secondary Schools," School Science and Mathematics, 49: 727-728, December, 1949.

primarily with the placement of traditional subject matter.[10]

The College Entrance Examination Board, an outgrowth of the Committee of Ten, set forth requirements which exerted a profound influence on the content of courses of study and reflected faith in the disciplinary aim.[11]

The realization that a single plan could not satisfy the needs of all pupils came to the National Committee on Mathematical Requirements in 1923. This committee gave a more satisfactory statement of aims than had previously been available. The following objectives were set up:

A. Practical aims, i. e., of immediate or direct usefulness in life:

1. Developing the ability to apply fundamental processes of arithmetic.

2. Understanding the language of algebra.

3. Developing the ability to understand and use algebraic techniques.

4. Developing the ability to understand and use graphs.

5. Developing familiarity with geometric forms.

6. Acquiring the ability to understand and use quantitative ideas.

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[10]Commission on Secondary School Curriculum, Progressive Education Association, Mathematics in General Education (New York: D. Appleton-Century Company, Inc., 1940), p. 4.

[11]Ibid., pp. 4-5.

B. Disciplinary aims, i. e., related to mental training:

1. Acquiring ideas and concepts used in quantitative thinking.

2. Developing the ability to think in quantitative terms.

3. Acquiring mental habits and attitudes useful in functional thinking.

C. Cultural Aims

1. Appreciating beauty in the geometric forms of nature, art, and industry.

2. Acquiring the ideals of perfection.

3. Appreciating the power of mathematics.[12]

The practical aims were introduced to make mathematics more functional. The disciplinary aims referred to developing concepts used in quantititative thinking and did not denote formal discipline based on the faculty theory as an explanation of transfer of training. The cultural aims included the appreciation of the place of mathematics in the environment, the beauty of forms, relationships, and exactness.[13]

Recognizing the need for more than one plan to meet the needs of high school pupils, the Joint Commission of the Mathematical Association of America and the National Council of Teachers of Mathematics presented two detailed outlines in 1940. The first recommended the traditional

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[12]The National Committee on Mathematical Requirements, The Reorganization of Mathematics in Secondary Education (Boston: Houghton Mifflin Company, 1927), p. 13.

[13]Rudyard K. Bent and Henry L. Kronenberg, Principles of Secondary Education (New York: McGraw-Hill Book Company, Inc., 1949), pp. 272-273.

sequence for pupils who expect to follow a profession requiring considerable mathematical training or who prefer such a course. The second plan proposed for the ninth grade a composite course consisting of arithmetic, graphic representations, algebra, numerical trigonometry, social mathematics, informal geometry, and logarithmic computation. The Joint Commission believed that by providing more than one plan, some study of mathematics could be made a part of every pupil's education irrespective of whether or not he planned to go to college. [14]

Kinsella pointed out the following interesting differences in the 1923 and 1940 reports:

1. The 1923 Report would have all students follow the same program in the ninth grade; the 1940 Report would segregate students into different courses in terms of previous preparation and ability.

2. The 1923 Report placed much less emphasis on the mathematics used by the consumer, home-maker, and citizen than did the 1940 Report.

3. The 1923 Report expressed the idea that the ninth grade would be the last time a considerable portion of the students would contact mathematics, and therefore proposed courses that would reveal the scope of mathematics most likely to be useful to him in the business and industrial world. The 1940 Report recommended that no year be considered a terminal year, and in its general mathematics

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[14] The Joint Commission of the Mathematical Society of America and the National Council of Teachers of Mathematics, The Place of Mathematics in Secondary Education, Fifteenth Yearbook (New York: Teachers College, Columbia University, 1940), pp. 204-211.

> proposals placed little stress on vocational needs but great emphasis on consumer-citizen needs.[15]

In the opinion of the Harvard Committee, probably little more than half the pupils in the ninth grade can derive genuine profit from substantial instruction in algebra or can be expected to master demonstrative geometry. Hence, the committee made the recommendation that

> . . . It is desirable to stimulate the interest of the mathematically inept students in the number relations of arithmetic and in the elementary principles of geometry by presenting mathematics in various disguises. . . In such novel forms these students can be brought to reexamine and improve their grasp of simple arithmetic and its application to practical problems.[16]

The 1940 Report of the Commission on Secondary School Curriculum stated:

> The purpose of general education is to provide rich and significant experience in the major aspects of living so directed as to promote the fullest possible realization of personal potentialities, and the most effective participation in a democratic society.[17]

In keeping with this purpose the Commission advocated that mathematics in general education should be determined by the needs of pupils in everyday life.

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[15]John J. Kinsella, "Some Reflections on the General Mathematics Situation," School Science and Mathematics, 54: 434, June, 1954.

[16]General Education in a Free Society, Report of the Harvard Committee (Cambridge: Harvard University Press, 1945), pp. 163-169.

[17]Commission on Secondary School Curriculum, Progressive Education Association, op. cit., p. 43.

The Commission on Post-War Plans recognized that there were neglected groups of students whose needs could not possibly be met in traditional mathematics courses and recommended three series of courses--sequential mathematics, related mathematics, and social mathematics.[18]

A second report of the Commission[19] assigned to the high schools a dual responsibility: providing sound mathematical training for future leaders of science, mathematics, and other learned fields; and insuring mathematical competence for the ordinary affairs of life as a part of a general education appropriate for the major fraction of the high school population. Accordingly, the Commission proposed a "double track" plan in mathematics. Track I was to be the traditional sequence reserved for those pupils who have the requisite ability, desire, or need for such work. Other pupils were to follow Track II--grade nine being devoted to general mathematics and grades ten to twelve continuing in parallel courses.

The minimum of mathematics for those not taking sequential courses has been identified by selecting the proposals upon which these two foregoing reports agree. These are listed as follows:

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[18]The First Report of the Commission on Post-War Plans, The Mathematics Teacher, 37: 226-232, May, 1944.

[19]The Second Report of the Commission on Post-War Plans, The Mathematics Teacher, 38: 195-221, May, 1945.

1. Arithmetic should be related to other topics, to problems, and to applications. Included should be

    a. Basic concepts as whole number, common fraction, decimal fraction, per cent, and ratio
    b. Fundamental operations
    c. Ratio and proportion
    d. Square root
    e. Measurement
    f. Percentage
    g. Tabular representation
    h. Verbal problems

        (1) Problems of the home, dealing with accounts, budgets, expenditures, bookkeeping, shelter, food, clothing, and medical care.

        (2) Problems of the community such as taxes and property insurance

        (3) Problems of banking as those related to savings accounts, checking accounts, mortgages, borrowing money

        (4) Problems of investments--postal savings, social security, stocks, and bonds

        (5) Problems of communication concerned with travel, transportation, parcel post, and sending money

2. Geometry

    a. Geometric concepts as point, line, angles, triangles, quadrilaterals, polygons, circles
    b. Direct measurement
    c. Properties of geometric figures
    d. Indirect measurement
    e. Geometric construction
    f. Cultural values of geometry

3. Algebra

    a. Algebraic concepts as literal number, signed number, exponent, radical, formula, equation

b. Fundamental operations
c. Equations
d. Ratio and proportion
e. Formulas
f. Problem solving

4. Statistics

5. Graphical representation

These abilities should be developed

a. To read, understand, and interpret graphs
b. To make comparisons between data represented by bar graphs
c. To recognize trends reflected in line graphs. . .
d. To construct simple statistical graphs
e. To make graphs of simple formulas
f. To show the use of graphs in solving problems

6. Numerical trigonometry[20]

On the basis of their reports, these national committees are in accord in insisting on a sound mathematical foundation in terms of recognized fundamentals of mathematics. On the one hand, capable students must be enabled to attain the maximum of mathematical training which can be achieved in high school. On the other hand, for those whose chief concern is immediate life preparation, a program must be provided that shall be both vocationally significant and culturally worthwhile.

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[20]E. R. Breslich, "Curriculum Trends in High School Mathematics," op. cit., pp. 63-67.

III. SURVEY OF RELATED INVESTIGATIONS

An examination of literature revealed no study made which recommended a program for high school general mathematics as determined by an appraisal of content and placement of subject matter. A limited number of studies concerning content of general mathematics courses at the college and high school level were reported and several investigations were made dealing with the evaluation of textbooks in the field.

One of the earliest studies was reported by Fuller[21] in 1928 when an experimental study in cooperative evaluation of junior high school mathematics textbooks was conducted by the Department of Psychology and Educational Research of the Los Angeles Public School System with the cooperation of the junior high school mathematics teachers. One of the six committees appointed was responsible for the analysis of the content of twenty-one junior high school mathematics textbooks in use. The committee on Criteria of Content listed the topics for the three-year course in junior high school mathematics with the per cent of material which, in the opinion of the committee, should be devoted to each.[22] The writer has summarized this analysis as follows:

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[21]Florence D. Fuller, Scientific Evaluation of Textbooks (New York: Houghton Mifflin Company, 1928), pp. 1-89.

[22]Ibid., pp. 14-16.

Arithmetic (40 per cent)

Topic	Per cent of space
Fundamentals	4
Fractions	3
Decimals	4
Aliquot parts	1
Percentage	2
Interest	4
Commission	2
Trade discount	2
Insurance	1
Taxes	1
Stocks, bonds, mortgages	2
Profit and loss	2
Problems of the home	4
Business forms	2
Denominate numbers	1
Statistical graphs	3
Ratio and proportion	1
Arithmetical square root	1
Total	40

Geometry (25 per cent)

Angles	3
Perimeters	1
Areas	6
Volumes	4
Construction	10
Metric system	1
Total	25

Algebra (33 per cent)

Positive and negative numbers	1
Literal notation	1
Formula	3
Linear equations	5
Algebraic addition	1
Algebraic subtraction	1
Algebraic multiplication	1
Algebraic division	1
Parenthesis	1

Topic	Per cent of space
Special products	2
Factoring	3
Algebraic fractions	3
Algebraic square root	0
Simultaneous equations	4
Algebraic graphs	1
Radicals	1
Quadratics	3
Algebraic proportion and variation	1
Total	33

Trigonometry (2 per cent)

Trigonometric functions	2
Total	2

The preceding study was concerned with the per cent of space that should be devoted to various topics, whereas the later study of Novinger[23] was concerned with the actual distribution of content in twenty-three ninth grade mathematics textbooks for non-academic pupils. The analysis revealed that arithmetic was the sole category on which all of these twenty-three textbooks published between 1934 and 1940 agreed as being essential to ninth grade mathematics. The division of content and percentage of distribution follows:[24]

Division of Content	Percentage Distribution
Arithmetic	22
Commercial arithmetic	16
Geometry	16
Algebra	15

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[23]Faith F. Novinger, "Distribution of Content in Twenty-three Ninth-grade Mathematics Textbooks for Non-academic Pupils," The Mathematics Teacher, 34: 165-168, April, 1942.

[24]Ibid., p. 165.

Division of Content	Percentage Distribution
Social uses	10
Consumer training	6
Graphs	5
Industrial arithmetic	4
Trigonometry	2
Tables	2
History of mathematics	1
Miscellaneous	1
Total	100

Beckmann[25] conducted a study designed to measure the level of mathematical competency as defined by the twenty-nine competencies promulgated by the Commission on Post-War Plans, and the relative gains in such competencies as a result of the study of algebra and general mathematics in the ninth grade. Participating in the study were forty-two Nebraska high schools in which 1296 pupils were enrolled in ninth grade algebra or general mathematics. Of the number, seventeen were schools requiring all ninth grade pupils to take algebra; twenty-five were schools requiring all to take general mathematics. In both algebra and general mathematics classes only about fifty per cent mastery of the competencies had resulted.

On the basis of the results of a study of mathematical achievement of the students in forty-three Iowa high schools, Ohlsen[26]

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[25]Milton W. Beckmann, "The Level of Mathematical Competency and Relative Gains in Competency of Pupils Enrolled in Algebra and General Mathematics," (unpublished Doctor's dissertation, University of Nebraska, Lincoln, 1951), p. 70.

[26]Merle M. Ohlsen, "Control of Fundamental Mathematical Skills and Concepts by High School Students," The Mathematics Teacher, 39: 365-72, December, 1946.

concluded that the high school students tested did not demonstrate a high degree of proficiency on many of the mathematical concepts and skills as defined by the Joint Commission.

Several studies have been made concerning the content of general mathematics courses at the college level. In some cases a procedure similar to that used in the present study has been employed.

Brown[27] made an analysis of more than fifty textbooks used in general mathematics at the college level. The analysis was made according to style of presentation and percentage of pages devoted to various topics. Textbooks were separated into three types according to the objectives stated by the author: the preparatory type, the combination cultural-preparatory type, and the cultural type.

A study was made by Gallion[28] to determine the content of general mathematics courses in the freshman program of selected colleges and universities and to obtain an evaluation of this content. Results of the evaluation were used to formulate a syllabus for use in freshman general mathematics courses at the college level.

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[27]Kenneth E. Brown, "What is General Mathematics ?," The Mathematics Teacher, 39: 329-31, November, 1946.

[28]Zachary T. Gallion, "A Determination and Appraisal of the Content of Freshman General Mathematics Courses in Selected Colleges and Universities," (unpublished Doctor's dissertation, Louisiana State University, Baton Rouge, 1955).

A study was made by Irvin[29] of the organization of instruction in arithmetic and basic mathematics in ninety-two selected schools situated in thirty-five states and the District of Columbia. The survey revealed that seventy-four of the ninety-two schools cooperating offered either a three-track or multiple-track mathematics program: sixteen offered a double-track program, either at the ninth or twelfth grade levels; twenty-nine offered related mathematics in connection with industrial arts and agricultural curricula; and nine of the schools offered special-interest mathematics courses.

The non-traditional mathematics courses were organized in a two-to-four year sequence in forty-three of the schools, and thirty-three schools offered two or three differentiated courses. The ten specialists who cooperated in the study agreed, for the most part, that a carefully developed sequence of two to four years would probably afford the best means of attaining the objectives of the non-traditional mathematics courses, and they further recommended that basic concepts and principles be taught through a spiral treatment of mathematical topics.

A study conducted by Arden K. Ruddell, University of Minnesota is presently under way. The results are to be used to propose a course in background mathematics for teachers of arithmetic and will furnish

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[29]Lee Irvin, "The Organization of Instruction in Arithmetic and Basic Mathematics in Selected Secondary Schools," The Mathematics Teacher, 46: 235-40, April, 1953.

the basis of a chapter in the Twenty-Fifth Yearbook of the National Council of Teachers of Mathematics which is scheduled to come off press in the Spring of 1959.[30]

IV. NEED FOR THE STUDY AS INDICATED BY CURRENT LITERATURE ON THE PROBLEM

In three of the studies previously cited, it was concluded that the results indicated a need for evaluation and revision of the high school mathematics program.

Ohlsen stated:

> The general index of 48.2% [who knew how to get the correct answers] indicates that the present high school mathematics program is not efficient in preparing youth for life as an ordinary citizen. These data reveal a need for evaluation and revision of the high school mathematics program. . .[31]

The study made by Beckmann also indicated the need for re-appraisal of the mathematics program in the high school. He pointed out:

> If we accept the competencies of the Commission on Post-War Plans as valid objectives for mathematics in the schools, then the low level of competency and the relatively small gains made by ninth grade students enrolled in algebra and general mathematics. . ., points out that one of the following conditions apply:

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[30]From a letter received from Foster E. Grossnickle, Chairman of Yearbook, National Council of Teachers of Mathematics.

[31]Ohlsen, op. cit., p. 371.

1. That our present curriculum in mathematics is poorly planned and developed
2. That the teaching of mathematics is poorly done in our schools or
3. That the competencies as proposed by the Post-War Commission have not been accepted as valid objectives by those planning the curriculum of the schools.[32]

Similar conclusions were reached by Irvin who summarized the opinion of the ten specialists as follows:

> It seems that the majority of the specialists evidently believe that the recommendations of the Commission on Post-War Plans furnish a point of departure from which to begin a thorough reorganization of the mathematics program.[33]

In a study of the schools of Kansas, Anderson and Dixon[34] found that the present double-track program is not meeting the desired objective; that even though different courses are being offered, the end product is the same.

Reeve stated:

> There is no question but that there is a definite trend to organize the curriculum along general mathematics lines. . . We must see to it that satisfactory textbooks in general mathematics be prepared to meet the needs of pupils in grades seven to twelve inclusive.[35]

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[32]Beckmann, op. cit., pp. 156-157.

[33]Irvin, op. cit., p. 236.

[34]Kenneth E. Anderson and L. J. Dixon, "A Study of the 'Double-Track' Program of Mathematics in the Secondary Schools of Kansas," School Science and Mathematics, 52: 637-40, November, 1952.

[35]W. D. Reeve, "Significant Trends in Secondary Mathematics," School Science and Mathematics, 49: 229, March, 1949.

Jones has made succinct comment on the existing situation:

> There is probably more dissatisfaction and uncertainty with regard to general mathematics now than at any other time since its beginning. . . At the ninth grade level there exist nearly as many or more problems than there were thirty years ago.[36]
>
> . . . . . .
>
> The spiral treatment is one that is being studied and experimented with in New York and Minnesota. The program attempts at each grade level to present worthwhile topics selected from the entire field of mathematics. Each year the spiral includes new topics, and old topics viewed from a more advanced standpoint and associated with additional applications. Theoretically all students, except those needing remedial help, may follow such a program as far as they wish or need to. . . Some experimentation of this sort is being encouraged in Illinois.[37]
>
> . . . . . .
>
> . . . All this diversity points out the existence of a need for thoughtful study, analysis, and action.[38]

The writer has dealt rather extensively with the studies made by Fuller, by Novinger, and by Irvin in order to determine just what was done in each of these investigations and to show that while certain phases of the present study are very similar to the three mentioned, the problem of this thesis in its entirety was not undertaken in these investigations. In fact, a careful search of educational literature failed to reveal a single study at the high school level which attempted to

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[36] Philip S. Jones, "Experimentation and Trends in General Mathematics," Education Digest, 18: 40, March, 1953.

[37] Ibid., p. 41.

[38] Ibid., p. 42.

formulate a program of general mathematics on the basis of an appraisal of content and placement of subject matter.

CHAPTER III

PRESENT ORGANIZATION OF THE GENERAL MATHEMATICS PROGRAM AS DETERMINED BY THE QUESTIONNAIRE RESULTS

The purpose of this chapter is to present data provided by the responses to the original questionnaire in order to determine the present organization of the general mathematics program in high schools of the United States.

During the spring semester of 1957 the original questionnaires were sent to the proper divisions of the various state departments of education. Within six weeks 93.75 per cent of the questionnaires had been returned and it was possible to close this phase of the investigation.

When analysis of the data began, it was apparent that the responses belonged in two categories: (1) where requirements were determined by the state and (2) where requirements were determined at the local level. In the former case responses were direct and tabularization facilitated the presentation of information. In the latter case responses were of two types--comments of a general nature, or specific information concerning the mathematics program in a specified number of schools within the state. These responses, though not readily adapted to tabulation, are included in the presentation. It seems evident that a clear conception of the organization of the general

mathematics program in the United States necessitates the consideration of responses from both categories.

I. MATHEMATICS REQUIREMENTS FOR HIGH SCHOOL GRADUATION

On forty of the forty-five questionnaire returns, the question concerning the number of units in mathematics required for high school graduation was answered. Tabulation of this information follows:

TABLE I

MATHEMATICS REQUIREMENTS FOR HIGH SCHOOL GRADUATION IN THE VARIOUS STATES

Number of Units Required	Frequency of Requirement	Per Cent of States Having Requirements
None	12	30.0
1	25	62.5
1-1/2	1	2.5
2	2	5.0
3	0	0.0
4	0	0.0
Total	40	100.0

It is interesting to note from Table I that 62.5 per cent of the state departments reporting on this item require one unit in mathematics for high school graduation and that in no state does the requirement exceed two units. In twenty-eight of the states one unit or more in mathematics is required for high school graduation; but in no

instance was any particular course specified as being required.

In addition to the direct answers to the question concerning mathematics requirements for high school graduation, many comments were included from states in which requirements are determined at the state level as well as those in which requirements are locally determined. Although it is not the purpose of this study to investigate the mathematics program in any particular state, the writer deemed it necessary to present these comments from the nineteen various state departments in order to clarify the present situation concerning mathematics requirements for high school graduation. This information is presented in Table II. The states in which requirements are determined at the local level are marked with an asterisk.

A study of Table II reveals that there is some tendency for local systems to increase the number of units in mathematics required by the state. It is further noted that two or more units are recommended by three of the eleven states which require one unit in mathematics for graduation and by three of the seven states having no prescribed requirement.

II. TITLES OF GENERAL MATHEMATICS COURSES LISTED

It was pointed out in a previous chapter that general mathematics courses are designated by a variety of terms. An examination of Table III reveals the different titles under which these courses were

TABLE II

COMMENTS FROM VARIOUS STATE DEPARTMENTS OF EDUCATION CONCERNING MATHEMATICS REQUIREMENTS FOR HIGH SCHOOL GRADUATION

State	Comment
Alabama	Statewide requirement--1 unit. Some systems require 2 or more.
*Arkansas	Varies with local school. We suggest that each school offer a minimum of 2 units.
*California	The college preparatory course requires 2 years mathematics.
*Delaware	0 to 4 units required depending upon curricula /curricular/ sequence.
Idaho	Minimum state requirement--1 unit. Many high schools require at least 2 units.
*Illinois	At least one recommended.
*Iowa	Up to local boards. We recommend 2-1/2 or 3.
Kansas	One course in mathematics is required. The state does not prescribe what that course shall be.
Louisiana	If Business Arithmetic or Senior Arithmetic is included, then 1-1/2 units in mathematics are required for graduation. Otherwise 2 units in mathematics are required. Credit cannot be given for both Business Arithmetic and Senior Arithmetic.
Maryland	We are considering increasing the number to 2.
Missouri	Trend to add the second unit.
*Nebraska	2 units recommended through accreditation.
New Hampshire	1 unit will be required effective September, 1958.
Nevada	Business Arithmetic or its equivalent may be accepted.
Oregon	Any mathematics subject is acceptable.
South Carolina	Requirement will be raised from 1 to 2 units in 1959-60.
Utah	Students may take algebra or some other mathematics and meet the state graduation requirement of one unit.

TABLE II (continued)

State	Comment
Washington	224 schools require 2 semesters 7 schools require 3 semesters 46 schools require 4 semesters 1 school requires 5 semesters 6 schools require 6 semesters
West Virginia	Any course in high school mathematics in any year grades 9-12.
*Wisconsin	No state requirement. Most high schools require 1 or 2.

TABLE III

TITLES OF GENERAL MATHEMATICS COURSES LISTED IN THE QUESTIONNAIRE

Title of Course	Frequency
General Mathematics	20
Basic Mathematics	4
Advanced General Mathematics	3
Consumer Mathematics	2
Functional Mathematics I	2
Functional Mathematics II	2
Applied Mathematics	1
Basic Mathematics I	1
Basic Mathematics II	1
Basic Mathematics III	1
Basic Mathematics IV	1
Functional Mathematics	1
Functional Mathematics III	1
Functional Mathematics IV	1
General Mathematics I	1
General Mathematics II	1
General Mathematics III	1
Ninth Grade Mathematics	1
Practical Mathematics	1
Refresher Mathematics	1
Senior General Mathematics	1
Senior Mathematics	1
Senior Mathematics Review	1
Total	50

listed in responses to the questionnaire. Of the forty-five returns, fifteen failed to list titles of courses since these state departments did not prescribe courses of study. The thirty state departments of education reporting on this item listed a total of fifty courses in general mathematics under twenty-three different titles. The excess of the number of courses over the number of state departments reporting is due to two factors: (1) more than one year of general mathematics is offered, or (2) courses which deviate from the traditional college preparatory sequence are offered under various titles at a particular grade level.

It may be noted from Table III that 66 per cent of the courses are offered under six titles and the remaining 34 per cent bear titles which are unique. Numerous titles which appear only once differ only slightly from another title; for example, Functional Mathematics and Functional Mathematics I, General Mathematics and General Mathematics I.

III. ORGANIZATION OF THE GENERAL MATHEMATICS PROGRAM AS DETERMINED BY PLACEMENT OF COURSES OFFERED

The placement of general mathematics courses offered in the various states indicates to some extent organization of the general mathematics program. Of the thirty state departments reporting one year of general mathematics offered, 90 per cent offer the course at

the freshman level. In the three cases where the course is offered in an elective year, the general mathematics program concludes with the one-year offering. Information concerning the placement of the initial general mathematics course is presented in Table IV.

TABLE IV

PLACEMENT OF GENERAL MATHEMATICS COURSE WHERE ONE COURSE IS OFFERED

Year Offered	Frequency
Freshman	21
Freshman or sophomore	5
Junior or senior	1
Elective	3
Total	30

In the previous section it was observed that the thirty state departments reported on fifty general mathematics courses. The information concerning the remaining twenty courses is presented in Table V.

A survey of Tables VI and VII provides a fairly comprehensive view of the organization of the high school general mathematics program. In 90 per cent of the thirty states, general mathematics is organized either as a one-year terminal course or as a two-year program. The frequency of offerings in the freshman year and again at the junior or senior level indicates that the two-year program does not follow in successive years.

TABLE V

PLACEMENT OF GENERAL MATHEMATICS COURSES WHERE ADDITIONAL COURSES ARE OFFERED

Year Offered	Frequency
Sophomore	3
Junior	3
Senior	3
Junior or senior	11
Total	20

TABLE VI

PLACEMENT OF GENERAL MATHEMATICS COURSES FROM THE COMPILED LIST OF COURSES

Year Offered	Frequency
Freshman	21
Sophomore	3
Junior	3
Senior	3
Freshman or sophomore	5
Junior or senior	12
Elective	3
Total	50

TABLE VII

ORGANIZATION OF GENERAL MATHEMATICS PROGRAM IN THE PARTICIPATING STATES

Scope of the Program	Frequency
One-year terminal course	16
Two-year course	11
Three-year sequence	0
Four-year sequence	3
Total	30

IV. CHAPTER SUMMARY

On the basis of the preceding data several conclusions may be drawn concerning the present high school general mathematics program. The fact that none of the states reporting prescribe any particular mathematics course as a required course for high school graduation indicates that mathematics curricula are flexible enough so that either the traditional college preparatory sequence or a general mathematics program may be pursued. Comments from various state departments reveal some tendency to increase mathematics requirements for high school graduation. Of the thirty states reporting on courses offered in general mathematics, 53.3 per cent make available a one-year terminal course and 36.7 per cent offer a two-year course.

CHAPTER IV

PRESENT CONTENT OF GENERAL MATHEMATICS COURSES AND PLACEMENT OF SUBJECT MATTER AS DETERMINED BY AN ANALYSIS OF SELECTED TEXTBOOKS CURRENTLY USED

This chapter is concerned with determining the present content of general mathematics courses and placement of subject matter as revealed by an analysis of selected adopted or approved general mathematics textbooks of the various state departments of education.

In the original questionnaire, respondents were requested to list titles, authors, and publishers of textbooks adopted or approved by the state for each course offered in general mathematics. Of the forty-five state departments returning questionnaires, twenty-five reported on this item and listed a total of thirty-four different general mathematics textbooks. The writer sent a letter[1] to each of the eleven textbook publishers requesting examination copies of the textbooks which had been selected for analysis. Response was gratifying and the writer was able to begin analysis of the selected textbooks in the early fall of 1957. Each of the textbooks was examined according to number and percentage of pages devoted to various topics. When analysis was complete, a combined list of topics was made.

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[1] Appendix B.

I. SELECTION OF GENERAL MATHEMATICS TEXTBOOKS USED IN THE STUDY

From the thirty-four different textbooks listed by the twenty-five state departments responding, it was first decided to select for analysis only those textbooks which were adopted or approved in two or more states. However, in some states only one textbook was listed for each course offered. If such states reported only one general mathematics course offered and if the textbook for that course was not listed elsewhere, then those states would have been eliminated from the study. In these cases it was decided to include the textbook in the analysis even though the book appeared on the approved list of only one state. Hence at least one textbook was selected for analysis for each general mathematics course reported to be offered in each of these twenty-five states. After this elimination process, there remained a total of twenty-four general mathematics textbooks to be analyzed. This list appears in the Bibliography of this work under the caption "General Mathematics Textbooks."

The question of "What is general mathematics?" was dealt with in a former chapter. The definition derived there furnished these two criteria which were used to determine whether or not a course should be placed in the category of general mathematics:

(1) Rather than being confined to any one mathematical subject, the content of a general mathematics course traverses several sucj subjects.

(2) Rather than being college preparatory, a general mathematics course aims at mathematical competency in meeting daily life problems.

After cursory inspection of the twenty-four textbooks, four additional ones were eliminated from the study. One of these, which dealt exclusively with arithmetic, violated the first criterion; three others, obviously college preparatory, were excluded from the study.

The twenty textbooks finally selected for analysis are enumerated in Table VIII. The purpose of the enumeration is to facilitate later presentation and discussion by referring to textbooks by number rather than by title and author. Duplication in title necessitates identification by author as well as title. In addition the frequency with which each textbook appeared on state-approved lists is presented in Table VIII.

II. PLACEMENT OF COURSES IN WHICH THE SELECTED TEXTBOOKS WERE REPORTED TO BE USED

An attempt was made to determine the placement of courses in which the selected general mathematics textbooks were used. Although the original questionnaire asked for the list of textbooks used in each general mathematics course, many of the state departments responded by enclosing a multiple listing of all general mathematics textbooks with no indication as to the course in which the book was used. The frequency with which each textbook analyzed was reported used in a first course in general mathematics or in a later course is presented in Table IX. Placement was considered undetermined in those cases where the textbook was in a multiple listing. Enumeration, following that of Table VIII, permits expeditious identification of textbooks by title only.

TABLE VIII

TITLES AND AUTHORS OF TEXTBOOKS ANALYZED AND FREQUENCY OF THEIR OCCURRENCE ON STATE-APPROVED LISTS

	Title	Author	Frequency
1.	Everyday General Mathematics Book I	Betz et al.	3
2.	Everyday General Mathematics Book II	Betz et al.	2
3.	General Mathematics	Edgerton and Carpenter	1
4.	Functional Mathematics Book I	Gager et al.	2
5.	Functional Mathematics Book II	Gager et al.	2
6.	General Mathematics	Grossnickle	2
7.	General Mathematics in Daily Activities	Hart and Gregory	1
8.	Mathematics in Daily Use	Hart et al.	3
9.	Basic Ideas of Mathematics	Lankford and Clark	7
10.	Mathematics for the Consumer	Lankford et al.	4
11.	The New Applied Mathematics	Lasley and Mudd	4
12.	Practical Mathematics	Lennes	1
13.	Economic Mathematics	Lennes and Sutton	3
14.	General Mathematics	Mallory and Skeen	3
15.	Mathematics for Today	Marino and Fawcett	4
16.	Making Mathematics Work	Nelson and Grime	7
17.	Everyday Problems in Mathematics	Nelson et al.	2
18.	Going Places with Mathematics	Peters	2
19.	Mathematics to Use	Potter et al.	5
20.	Refresher Arithmetic and Practical Applications	Stein	2

TABLE IX

PLACEMENT OF COURSES IN WHICH SELECTED TEXTBOOKS WERE REPORTED TO BE USED AND FREQUENCY OF THEIR USE

	First Course	Later Course	Undetermined
1. Everyday General Mathematics Book I	1	0	2
2. Everyday General Mathematics Book II	0	2	0
3. General Mathematics	1	0	0
4. Functional Mathematics Book I	1	0	1
5. Functional Mathematics Book II	0	1	1
6. General Mathematics	1	0	1
7. General Mathematics in Daily Activities	0	0	1
8. Mathematics in Daily Use	0	1	2
9. Basic Ideas of Mathematics	3	2	2
10. Mathematics for the Consumer	2	1	1
11. The New Applied Mathematics	1	1	2
12. Practical Mathematics	1	0	0
13. Economic Mathematics	1	1	1
14. General Mathematics	2	1	0
15. Mathematics for Today	2	0	2
16. Mathematics at Work	7	0	0
17. Everyday Problems in Mathematics	2	0	0
18. Going Places with Mathematics	2	0	0
19. Mathematics to Use	4	0	1
20. Refresher Mathematics and Practical Applications	1	0	1

Study of Table IX reveals that for only six of the twenty textbooks analyzed can it definitely be determined that the textbook is used in first courses or in later courses of general mathematics in the twenty-five states reporting. It is concluded, then, that placement of the present subject matter of general mathematics courses cannot be determined by textbook analysis.

III. PROCEDURE USED IN ANALYZING THE SELECTED GENERAL MATHEMATICS TEXTBOOKS AND RESULTS OF THE ANALYSIS

As examination of textbooks began, it became apparent almost immediately that chapter or unit headings alone would not adequately reveal the topical content of the subject matter. Indeed in some cases, the chapter headings indicated in no way the content of the chapter. For example a chapter entitled "Life in the Midcentury" dealt with fundamental operations with whole numbers; one entitled "Mathematics in Home and Community Life" dealt with insurance, taxation, and investments. Since chapter headings could not be considered accurate indications of topical content, it was necessary to examine the subheadings within each chapter. In the analysis of the textbooks each topic was listed in the order in which it appeared in the main body of the book and the number of pages occupied by the topic was recorded. After tabulation of these data was complete, the percentage of space devoted to each topic was computed. The number of pages considered

to be devoted to a topic excluded those pages devoted to cumulative reviews and practice sets, general reviews and summaries, standardized tests, and comprehensive mastery tests. Also excluded were pages of answers, indexes, and tables of square roots and trigonometric ratios.

Data relative to the number and percentage of pages devoted to various topics in each of the textbooks analyzed are presented in Appendix C in Table XIV through Table XXXIII. Examination of these tables shows that arithmetic is the only area of mathematics included in the content of all of the textbooks analyzed. Moreover, it is evident that there is little or no agreement as to what topics in arithmetic are included or how much space should be devoted to each. Wide variation is noted in the kind and number of different mathematics subjects introduced. For example, four of the textbooks include topics from only two mathematics subjects and these are in three different combinations: (1) arithmetic and algebra, (2) arithmetic and geometry, and (3) arithmetic and statistics. The number of mathematics subjects included in the textbooks ranges from combinations of two to a total of five where the five subjects include topics from arithmetic, geometry, algebra, trigonometry, and statistics.

Further study of the tables in Appendix C shows that there is little agreement in the kind and number of topics introduced from the various mathematics subjects. For example, topics in plane geometry are omitted entirely in two textbooks; most of the books analyzed include

intuitive geometry; a few progress as far as formal proof. In some textbooks, topics in algebra are limited to linear equations solved by one process; in others, topics extend into quadratic equations. Similar divergence is noted in each of the mathematics subjects included in the content of the twenty textbooks analyzed.

This phase of the thesis proceeds on the assumption that topical content of a general mathematics textbook used in a particular course is indicative of the content of the course. On this basis, then, it may be concluded that there is little agreement as to the kind and number of topics included in the general mathematics programs of the various states.

IV. FORMULATION OF THE COMBINED LIST OF TOPICS

The initial step in compiling the combined list of topics was concerned with classifying each topic in the original list according to its mathematics subject. For example, the topic "Fundamental processes with integers" is classified as arithmetic. In six of the twenty textbooks, subject matter material was organized according to mathematics subjects; in the remaining books, topics from various mathematics subjects occurred passim. The compiled list of topics represent five mathematics subjects: arithmetic, geometry, algebra, trigonometry, and statistics.

In order to avoid compiling an unduly long roster, it was

necessary for the writer to exercise a great deal of liberty in designating the various topics in the combined list. For example, the topic "History of mathematics" is inclusive of both the original titles "History and importance of mathematics" and "Development of mathematics." An attempt was made to designate each topic as succinctly as possible without sacrificing clarity. Care was taken to avoid overlapping, repetition, or omission of topics.

In the presentation of the combined list of terms, no reference is made to the frequency with which each topic occurred in each of the twenty textbooks analyzed. The fact that a topic, as it appears in the combined list, was not included verbatim or in cognizable phraseology in the topical content of a particular textbook was no indication that the topic was omitted from the book. It could have been included under a different heading. For example, the topic "Area of a trapezoid," which appears in the geometry category in the combined list of topics, does not appear in the list of topics in Textbook Number 1 as presented in Appendix C, Table XIV. However, more detailed examination of the textbook reveals that this subject matter is presented in Topic Number 15 within a sub-topic placed in the algebra category. It is evident that determination of the frequency of occurrence of each topic would have presented a Gargantuan task; moreover, the relevancy of this information seemed questionable. The combined list of 126 topics included in the twenty textbooks follows.

THE COMBINED LIST OF TOPICS

Arithmetic

1. History of mathematics
2. Fundamental processes with integers
3. Rounding off numbers
4. Reading and writing integers
5. Denominate numbers
6. Fundamental processes with fractions
7. Reducing fractions to lowest terms
8. Equivalent fractions
9. Finding a number when a fractional part is known
10. Finding what part one number is of another
11. Changing the form of fractions
12. Aliquot parts
13. Reading and writing decimal fractions
14. Changing common fractions to decimals
15. Fundamental processes with decimals
16. Changing decimals to common fractions
17. Significant digits
18. Writing per cents as decimals
19. Writing per cents as fractions
20. Finding a per cent of a number
21. Writing decimals as per cents
22. Writing fractions as per cents
23. Finding a number when a per cent of it is known
24. Finding what per cent one number is of another
25. Finding per cent of increase or decrease
26. Personal and family budgets
27. Checking accounts
28. Purchase of food and clothing
29. Installment plan buying
30. Cost of owning and operating an automobile
31. Cost of owning or renting a home
32. Savings and investments
33. Bills and accounts
34. Simple interest
35. Compound interest
36. Postal and telegraph service
37. Public transportation
38. Borrowing money
39. Bank discount

40. Promissory notes
41. Taxation
42. Insurance
43. Finding selling price
44. Trade discount
45. Profit and loss
46. Depreciation
47. Commission and brokerage
48. Ratio and proportion
49. Graphical representation
50. Scale drawing
51. Squares and square root
52. Liquid and dry measure
53. English and metric systems
54. Tip and rim speed

Geometry

55. Measuring and drawing angles
56. Kinds of angles
57. Construction of perpendiculars
58. Construction of bisectors
59. Construction of parallels
60. Construction of tangents
61. Construction of triangles
62. Angle relationship in parallel lines
63. Classification of triangles by sides
64. Classification of triangles by angles
65. Sum of the angles of a triangle
66. Sum of the angles of a polygon
67. Circumference of a circle
68. Perimeter of plane figures
69. Area of a rectangle
70. Area of a square
71. Area of a trapezoid
72. Area of a circle
73. Area of a triangle having given the base and altitude
74. Area of a triangle having given the three sides
75. Area of a parallelogram
76. Volume of a rectangular solid
77. Volume of a cylinder
78. Volume of a pyramid
79. Volume of a cone
80. Volume of a sphere

81. Volume of a cube
82. Volume of a prism
83. Symmetry
84. Indirect measurement
85. Similar triangles
86. Similar polygons
87. Use of the mil
88. Ratio and proportion
89. Rule of Pythagoras

Algebra

90. Mathematical symbols
91. Equations solved by addition, subtraction, multiplication, and division processes
92. Equations with fractional coefficients
93. Decimal equations
94. Literal equations
95. Fractional equations
96. Quadratic equations solved by factoring
97. Quadratic formula
98. Curved line graphs
99. Simultaneous equations
100. Parentheses
101. Writing formulas
102. Graph of a formula
103. Evaluating algebraic expressions
104. Fundamental processes with signed numbers
105. Fundamental processes with monomials
106. Fundamental processes with polynomials
107. Factoring a quadratic trinomial
108. Factoring a perfect trinomial square
109. Factoring the difference of two squares
110. Working with fractions that require factoring
111. The three signs of a fraction
112. Powers
113. Roots
114. Radicals
115. Direct variation
116. Inverse variation

Trigonometry

117. Tangent ratio
118. Sine ratio

119. Cotangent ratio
120. Cosine ratio

Statistics

121. Sampling
122. Frequency
123. Average
124. Mode
125. Median
126. Arranging data

CHAPTER V

IMPORTANCE AND GRADE PLACEMENT OF TOPICS FROM THE COMBINED LIST AS DETERMINED BY RATINGS AND COMMENTS OF THE EVALUATING PANEL

I. SELECTION OF THE EVALUATING PANEL

During the summer of 1957, the writer requested M. H. Ahrendt, Executive Secretary of the National Council of Teachers of Mathematics, together with the Board of Directors, to recommend a list of some thirty or thirty-five leaders in the field who, in their opinion, were qualified to evaluate high school courses in general mathematics. In response to the request, Mr. Ahrendt stated that, after consultation with other members of the Board, he decided that the best approach in compiling the list was to consult the programs which had been presented at recent conventions of the National Council of Teachers of Mathematics, to select topics which were related to high school general mathematics, and to identify the speakers involved. Under separate cover, he sent copies of five programs for conventions held in 1956 and 1957 in which thirty-four such persons were identified.

The prior suggestion by the writer's faculty-advisor committee (that the evaluating panel need not be restricted to this group) was repeated by Mr. Ahrendt; hence, certain additions described below were made.

In the original questionnaires to the state departments of education, respondents were requested to indicate whether or not there was a state supervisor of mathematics in the state, and if so, to give the name of the person who held this position. Of the five persons listed as state supervisors of mathematics, one was included in the list from Mr. Ahrendt; the writer, being familiar with the work of another of these supervisors, added that name to the list of prospective panel members. Upon recommendation of one of the members of the faculty-advisory committee, one other person was added to the list. The members who agreed to serve on the evaluating panel and their areas of service are listed in Table X.

The thirty members represent twenty different states and the District of Columbia. Of the number, 50 per cent are in the field of high school teaching; 40 per cent are engaged in instruction in higher education; 6.7 per cent are supervisors of mathematics; and 3.3 per cent are research specialists in the field.

II. IMPORTANCE OF TOPICS IN THE COMBINED LIST AS DETERMINED BY THE RATINGS OF THE EVALUATING PANEL

Each member of the evaluating panel was sent a copy of the combined list of topics and a letter explaining how the topics were to be evaluated as to importance and grade placement.[1] In order to

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[1]Appendix D.

TABLE X

MEMBERS OF THE EVALUATING PANEL AND THEIR FIELD OF SERVICE

Member of Panel	Field of Service
Robert E. Dinkel	Culver City High School, Culver City, California
Jen Jenkins	Bethany College, Lindborg, Kansas
Marie Wilcox	Thomas Carr Howe High School, Indianapolis, Indiana
Henry Swain	New Tier Township High School, Winnetka, Illinois
William A. Gager	University of Florida, Gainesville, Florida
Kenneth E. Brown	U. S. Office of Education, Washington, D. C.
Karl S. Kalman	President of the Association of Teachers of Mathematics in Philadelphia and Vicinity, Abraham Lincoln High School, Philadelphia, Pennsylvania
F. Lynwood Wren	George Peabody College, Nashville, Tennessee
Kenneth B. Henderson	University of Illinois, Urbana, Illinois
Eunice Bowers	Junior High School Mathematics Supervisor, Baltimore, Maryland
Jessie May Hoag	Southwestern Louisiana Institute, Lafayette, Louisiana
Alice M. Hach	Public Schools, Racine, Wisconsin
James H. Zant	Oklahoma Agricultural and Mechanical College, Stillwater, Oklahoma
Joseph N. Payne	University of Michigan, Ann Arbor, Michigan
Milton Beckmann	University High School, Lincoln, Nebraska

TABLE X (continued)

Member of Panel	Field of Service
Mildred Keiffer	Public Schools, Cincinnati, Ohio
William L. Schaaf	Brooklyn College, Brooklyn, New York
Annie John Williams	Julian S. Carr Junior High School, Durham, North Carolina
Charles Butler	Western Michigan College of Education, Kalamazoo, Michigan
John Bryan	North High School, Omaha, Nebraska
Harold P. Fawcett	Ohio State University, Columbus, Ohio
Dale Carpenter	Mathematics Education Supervisor Secondary Curriculum Division, Los Angeles, California
Max Peters	Long Island City High School, Queens, New York
W. I. Layton	Stephen F. Austin State College, Nacogdoches, Texas
Robert C. McLean, Jr.	Washington High School, Los Angeles, California
Catherine A. V. Lyons	University High School, Pittsburgh, Pennsylvania
Robert J. Oliver	Roseburg High School, Roseburg, Oregon
Frances Story	St. Charles High School, St. Charles, Missouri
John J. Kinsella	New York University, New York, New York
Margaret Rheinbolt	Wilmington High School, Wilmington, Delaware

determine the importance of each topic, the writer asked that each topic be rated as to its importance according to the following rating scale:

4--Topic is essential
3--Topic is highly important
2--Topic is of some importance
1--Topic is of doubtful importance
0--Topic should be omitted

As each response was received, results were tabulated for each topic. In order to present this information in the most meaningful form, the mean rating was computed for each topic and then the topics were ranked within each of the five subject categories in order of importance from highest to lowest. The mean rating was determined by the formula

$$M = \frac{\Sigma FV}{N}$$

where
M is the mean rating
V is the point value of each rating
F is the frequency of each rating
N is the total number of responses

Study of Table XI, in which the mean rating of each topic in the combined list is presented, reveals the highest mean rating to be 3.87 for the topic "Fundamental processes with integers." This topic was consistently ranked as "Essential" by all respondents except one, who indicated that the topic should be included in a course of remedial arithmetic rather than general mathematics. The lowest mean rating revealed is .63 for the topic "Tip and rim speed," which thirteen of the respondents indicated should be omitted. It is further noted that only

TABLE XI

MEAN RATING OF EACH TOPIC IN THE COMBINED LIST

Topic	Mean Rating
ARITHMETIC	
Fundamental processes with integers	3.87
Writing per cents as decimals	3.83
Finding a per cent of a number	3.83
Fundamental processes with fractions	3.80
Reading and writing decimal fractions	3.80
Fundamental processes with decimals	3.80
Changing common fractions to decimals	3.77
Reading and writing integers	3.73
Equivalent fractions	3.73
Finding what per cent one number is of another	3.73
Graphical representation	3.73
Writing per cents as fractions	3.67
Finding what part one number is of another	3.63
Reducing fractions to lowest terms	3.60
Writing decimals as per cents	3.60
Finding per cent of increase or decrease	3.60
Rounding off numbers	3.57
Finding a number when a fractional part is known	3.57
Changing the form of fractions	3.57
Writing fractions as per cents	3.57
Denominate numbers	3.53
Changing decimals to common fractions	3.53
Scale drawing	3.50
Finding a number when a per cent of it is known	3.47
Ratio and proportion	3.47
Simple interest	3.40
Significant digits	3.27
Liquid and dry measure	3.17
Borrowing money	3.13
English and Metric systems	3.07
Aliquot parts	3.03
Checking accounts	3.00
Taxation	2.97
Savings and investments	2.93
Compound interest	2.93

TABLE XI (continued)

Topic	Mean Rating
Squares and square root	2.93
Installment plan buying	2.90
Insurance	2.87
Cost of owning and operating an automobile	2.77
Personal and family budgets	2.63
Bills and accounts	2.60
Finding selling price	2.60
Profit and loss	2.60
Cost of owning or renting a home	2.50
Depreciation	2.50
Promissory notes	2.47
Purchase of food and clothing	2.43
Bank discount	2.27
Trade discount	2.27
History of mathematics	2.07
Commission and brokerage	2.07
Postal and telegraph service	1.53
Public transportation	1.53
Tip and rim speed	.63
GEOMETRY	
Area of a square	3.83
Area of a rectangle	3.80
Area of a triangle having given the base and altitude	3.73
Volume of a cube	3.53
Volume of a rectangular solid	3.50
Measuring and drawing angles	3.40
Rule of Pythagoras	3.40
Volume of a cylinder	3.37
Area of a parallelogram	3.33
Kinds of angles	3.27
Area of a circle	3.27
Indirect measurement	3.27
Ratio and proportion	3.27
Area of a trapezoid	3.17
Similar triangles	3.07
Sum of the angles of a triangle	3.00
Circumference of a circle	3.00

TABLE XI (continued)

Topic	Mean Rating
Perimeter of plane figures	3.00
Construction of perpendiculars	2.87
Construction of bisectors	2.83
Symmetry	2.83
Construction of triangles	2.80
Classification of triangles by angles	2.77
Construction of parallels	2.73
Classification of triangles by sides	2.73
Volume of a pyramid	2.67
Volume of a cone	2.67
Similar polygons	2.67
Volume of a sphere	2.63
Angle relationship in parallel lines	2.37
Construction of tangents	2.30
Volume of a prism	2.07
Area of a triangle having given three sides	1.97
Sum of the angles of a polygon	1.63
Use of the mil	1.40
ALGEBRA	
Mathematical symbols	3.77
Equations solved by addition, subtraction, multiplication and division processes	3.63
Evaluating algebraic expressions	3.47
Fundamental processes with signed numbers	3.40
Graph of a formula	3.13
Fundamental processes with monomials	3.03
Writing formulas	2.97
Literal equations	2.93
Parentheses	2.90
Powers	2.77
Equations with fractional coefficients	2.73
Roots	2.57
Decimal equations	2.53
Fractional equations	2.53
Simultaneous equations	2.47
Direct variation	2.47
Curved line graphs	2.37

TABLE XI (continued)

Topic	Mean Rating
Inverse variation	2.33
Fundamental processes with polynomials	2.30
Radicals	2.30
Quadratic equations solved by factoring	2.17
Quadratic formula	2.17
Factoring a quadratic trinomial	2.17
Factoring the difference of two squares	2.17
Factoring a perfect trinomial square	2.17
The three signs of a fraction	2.03
Working with fractions that require factoring	1.63
TRIGONOMETRY	
Tangent ratio	3.00
Sine ratio	2.67
Cosine ratio	2.67
Cotangent ratio	1.93
STATISTICS	
Average	3.43
Arranging data	3.20
Median	3.13
Frequency	2.90
Mode	2.90
Sampling	2.80

eight of the 126 topics have a mean rating of 2.00 or less.

In the list of combined topics sent to members of the evaluating panel, space was left below each of the five subject categories for listing additional topics considered necessary. Only eight of the respondents listed topics to be added. In the presentation of these additional topics which follows, ratings of topics are omitted since in no case, was a topic listed by more than one member of the evaluating panel.

ADDITIONAL TOPICS LISTED BY INDIVIDUALS ON THE EVALUATING PANEL

Arithmetic

Present value, i. e., $(1+i)^{-n}$
Amortization
Life insurance plans
Approximate numbers
Numeral systems other than decimal
Per cent of error
Estimating results

Geometry

Nature of definition
Inductive reasoning
Concepts of inverse, converse, and contrapositive
Indirect proof
Euler's circle
Detection of logical fallacies
Deductive processes
Approximate nature of measurement
Angular measurement

Algebra

Concept of identity vs. equation
Number system

Power law
Exponential law
Complex numbers
Commutative, associative, distributive laws

Trigonometry

Angle of elevation and depression
Slide rule
Oblique triangle

Statistics

Index numbers
Harmonic average
Simple probability

Since none of the twenty-eight additional topics was listed by more than one member of the evaluating panel, it was not considered necessary to have these additional topics rated by the entire evaluating panel. There were two reasons for this decision: (1) Many of these additional topics were included in the topics of the combined list in a broader classification; for example, "Life insurance plans" was included in topic number forty-two of the combined list, "Insurance." (2) There were indications from comments of six members of the evaluating panel that the number of topics included in any year and the extent to which each topic was developed should be determined by the purpose of the course in a particular school and by the ability and background of the pupils enrolled in the course.

These six comments follow:

(1) Topics in the check list are for the average student. I do like the idea of having a general mathematics program for the average pupil as checked above.

Additional topics are for the more able students.

(2) . . .Additional topics indicate the intensity with which various topics may be developed with more able or mature students.

(3) We believe in having a very flexible program in general mathematics because of the wide range of ability among students.

(4) Some of the students will have a good ability in the fundamentals at the ninth grade, while others will probably be poor in fundamentals even at the twelfth grade. Additional topics are indicated for the students of above average ability.

(5) The extent to which topics are developed will vary with the purpose of the course in each school.

(6) As you well know, the subject matter included in any general mathematics course depends upon the quality of the class being taught. Many of the topics given here could not possibly be presented in a weak class.

The decision to consider these twenty-eight additional topics as optional material is upheld by the foregoing comments.

III. GRADE PLACEMENT OF TOPICS AS DETERMINED BY CLASSIFICATIONS AND SUBJECTIVE COMMENTS OF MEMBERS OF THE EVALUATING PANEL

When the combined list of topics was sent to the appraisal group, members were requested to indicate in the check list the grade or grades in which each topic should be included in a high school program of general mathematics. Hence, a topic could be placed in the program of general mathematics in any one of the four high school years, in any combination of two years, in any combination of three years, in all four

years, or in no year if the topic were to be omitted. This meant that there were sixteen possible ways in which a topic could be placed.

As returns were received, each topic was tallied in the proper one of the sixteen classifications. When the thirty responses were obtained and recorded, the tally sheets were used to determine agreement in placement for each of the 126 topics in the combined list. For example, the topic "Writing per cents as fractions" was placed as follows by members of the evaluating panel:

Number of panel members reporting	High school year placement
16	First year
4	First and second year
2	First and third year
2	First, second, and third year
6	First, second, third, and fourth year

Examination of these placements indicates that 100 per cent of the panel members agreed that this topic should be placed in the freshman year, 40 per cent that the topic should be included in the sophomore year, 33.3 per cent that the topic should be placed in the junior year, and 20 per cent that the topic should be in the senior year. In like manner the percentage of agreement was computed for each of the 126 topics.

The percentage of agreement of the panel members in placing the 126 topics in a high school program of general mathematics is presented in Table XII. Study of the table reveals that a majority of the panel members agreed in placing 107 of the 126 topics in at least one year of a

TABLE XII

PER CENT OF MEMBERS OF THE EVALUATING PANEL PLACING TOPICS IN EACH OF THE FIVE CLASSIFICATIONS

Topic	Per cent of panel members placing topics in each classification				
	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR	OMIT
Arithmetic					
Fundamental processes with integers	96.7	56.7	53.3	53.3	3.3
Writing per cents as decimals	100.0	26.7	26.7	16.7	0.0
Finding a per cent of a number	96.7	33.3	26.7	20.0	3.3
Fundamental processes with fractions	96.7	53.3	36.7	30.0	3.3
Reading and writing decimal fractions	96.7	30.0	16.7	16.7	3.3
Fundamental processes with decimals	96.7	43.3	33.3	30.0	3.3
Changing common fractions to decimals	96.7	33.3	20.0	20.0	3.3
Reading and writing integers	86.7	26.7	20.0	16.7	6.7
Equivalent fractions	93.3	30.0	30.0	20.0	3.3
Finding what per cent one number is of another	96.7	33.3	20.0	20.0	0.0
Graphical representation	100.0	66.7	56.7	53.3	0.0
Writing per cents as fractions	100.0	40.0	33.3	20.0	0.0
Finding what part one number is of another	90.0	33.3	20.0	16.7	3.3
Reducing fractions to lowest terms	96.7	53.3	20.0	20.0	3.3
Writing decimals as per cents	93.3	33.3	26.7	26.7	3.3
Finding per cent of increase or decrease	76.7	26.7	26.7	26.7	0.0
Rounding off numbers	93.3	43.3	26.7	26.7	3.3
Finding a number when a fractional part is known	83.3	26.7	26.7	20.0	3.3
Changing the form of fractions	96.7	40.0	20.0	20.0	3.3
Writing fractions as per cents	96.7	33.3	23.3	16.7	3.3

TABLE XII (continued)

Topic	Per cent of panel members placing topics in each classification				
	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR	OMIT
Denominate numbers	93.3	40.0	33.3	30.0	0.0
Changing decimals to common fractions	96.7	33.3	20.0	16.7	3.3
Scale drawing	90.0	53.3	50.0	46.7	0.0
Finding a number when a per cent of it is known	70.0	36.7	36.7	33.3	0.0
Ratio and proportion	83.3	66.7	56.7	46.7	0.0
Simple interest	96.7	46.7	43.3	60.0	0.0
Significant digits	53.3	53.3	53.3	33.3	0.0
Liquid and dry measure	93.3	43.3	26.7	20.0	0.0
Borrowing money	36.7	20.0	43.3	70.0	0.0
English and metric systems	83.3	70.0	46.7	46.7	0.0
Aliquot parts	70.0	30.0	16.7	13.3	10.0
Checking accounts	46.7	16.7	46.7	53.3	0.0
Taxation	60.0	33.3	36.7	60.0	3.3
Savings and investments	36.7	30.0	46.7	80.0	0.0
Compound interest	40.0	30.0	33.3	70.0	0.0
Squares and square root	53.3	46.7	36.7	30.0	0.0
Installment plan buying	20.0	20.0	40.0	76.7	0.0
Insurance	53.3	30.0	36.7	76.7	6.7
Cost of owning and operating an automobile	26.7	26.7	30.0	66.7	3.3
Personal and family budgets	36.3	26.7	53.3	53.3	0.0
Bills and accounts	30.0	6.7	36.7	70.0	3.3
Finding selling price	56.7	26.7	30.0	53.3	6.7
Profit and loss	53.3	16.7	33.3	53.3	3.3
Cost of owning or renting a home	16.7	16.7	33.3	80.0	3.3

TABLE XII (continued)

Topic	Per cent of panel members placing topics in each classification				
	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR	OMIT
Depreciation	26.7	6.7	30.0	70.0	0.0
Promissory notes	26.7	16.7	36.7	76.7	3.3
Purchase of food and clothing	36.7	10.0	46.7	60.0	6.7
Bank discount	16.7	6.7	36.7	66.7	6.7
Trade discount	60.0	26.7	33.3	26.7	6.7
History of mathematics	76.7	66.7	80.0	80.0	0.0
Commission and brokerage	16.7	6.7	33.3	63.3	0.0
Postal and telegraph service	30.0	16.8	10.0	30.0	36.7
Public transportation	33.3	6.7	20.0	33.3	33.3
Tip and rim speed	33.3	23.3	10.0	26.7	43.3
Geometry					
Area of a square	96.7	70.0	23.3	13.3	0.0
Area of a rectangle	96.7	56.7	20.0	13.3	0.0
Area of a triangle having given the base and altitude	80.0	60.0	26.7	13.3	0.0
Volume of a cube	73.3	50.0	50.0	10.0	0.0
Volume of a rectangular solid	73.3	46.7	56.7	13.3	0.0
Measuring and drawing angles	73.3	53.3	26.7	10.0	0.0
Rule of Pythagoras	83.3	70.0	33.3	16.7	0.0
Volume of a cylinder	63.3	40.0	46.7	16.7	0.0
Area of a parallelogram	70.0	40.0	33.3	13.3	0.0
Kinds of angles	73.3	40.0	26.7	10.0	3.3

TABLE XII (continued)

Topic	Per cent of panel members placing topics in each classification				
	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR	OMIT
Area of a circle	86.7	56.7	26.7	13.3	0.0
Indirect measurement	50.0	46.7	50.0	43.3	3.3
Ratio and proportion	86.7	76.7	56.7	46.7	0.0
Area of a trapezoid	70.0	40.0	23.3	10.0	3.3
Similar triangles	46.7	53.3	46.7	20.0	0.0
Sum of the angles of a triangle	70.0	60.0	23.3	10.0	0.0
Circumference of a circle	86.7	53.3	20.0	13.3	0.0
Perimeter of plane figures	80.0	53.3	23.3	13.3	0.0
Construction of perpendiculars	63.3	46.7	23.3	3.3	3.3
Construction of bisectors	53.3	53.3	26.7	3.3	3.3
Symmetry	63.3	63.3	40.0	20.0	0.0
Construction of triangles	53.3	40.0	36.7	20.0	6.7
Classification of triangles by angles	53.3	46.7	26.7	10.0	3.3
Construction of parallels	53.3	46.7	23.3	3.3	3.3
Classification of triangles by sides	53.3	50.0	23.3	6.7	3.3
Volume of a pyramid	50.0	50.0	46.7	20.0	3.3
Volume of a cone	53.3	53.3	46.7	13.3	3.3
Similar polygons	23.3	46.7	53.3	20.0	6.7
Volume of a sphere	40.0	36.7	53.3	23.3	0.0
Angle relationship in parallel lines	36.7	53.3	26.7	13.3	3.3
Construction of tangents	40.0	46.7	30.0	10.0	10.0
Volume of a prism	46.7	36.7	40.0	20.0	3.3
Area of a triangle having given three sides	30.0	30.0	30.0	23.3	23.3
Sum of the angles of a polygon	30.0	53.3	30.0	13.3	6.7
Use of the mil	20.0	20.0	20.0	40.0	30.0

TABLE XII (continued)

Topic	Per cent of panel members placing topics in each classification				
	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR	OMIT
Algebra					
Mathematical symbols	100.0	63.3	40.0	33.3	0.0
Equations solved by addition, subtraction, multiplication, and division processes	96.7	63.3	26.7	26.7	0.0
Evaluating algebraic expressions	80.0	56.7	36.7	26.7	0.0
Fundamental processes with signed numbers	83.3	60.0	26.7	16.7	0.0
Graph of a formula	70.0	66.7	33.3	30.0	3.3
Fundamental processes with monomials	56.7	53.3	30.0	13.3	3.3
Writing formulas	83.3	53.3	26.7	26.7	3.3
Literal equations	60.0	60.0	53.3	26.7	3.3
Parentheses	66.7	50.0	43.3	26.7	6.7
Powers	53.3	43.3	50.0	16.7	10.0
Equations with fractional coefficients	63.3	60.0	43.3	26.7	0.0
Roots	63.3	36.7	46.7	16.7	0.0
Decimal equations	56.7	63.3	40.0	16.7	0.0
Fractional equations	53.3	66.7	56.7	16.7	3.3
Simultaneous equations	33.3	43.3	53.3	20.0	16.7
Direct variation	46.7	46.7	66.7	33.3	6.7
Curved line graphs	16.7	43.3	43.3	26.7	16.7
Inverse variation	43.3	46.7	66.7	30.0	6.7
Fundamental processes with polynomials	33.3	43.3	33.3	13.3	20.0
Radicals	26.7	26.7	46.7	16.7	20.0
Quadratic equations solved by factoring	20.0	33.3	36.7	6.7	26.7

TABLE XII (continued)

Topic	Per cent of panel members placing topics in each classification				
	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR	OMIT
Quadratic formula	20.0	46.7	33.3	16.7	26.7
Factoring a quadratic trinomial	26.7	36.7	40.0	6.7	26.7
Factoring the difference of two squares	26.7	26.7	36.7	13.3	26.7
Factoring a perfect trinomial square	26.7	30.0	33.3	13.3	26.7
The three signs of a fraction	26.7	33.3	43.3	6.7	20.0
Working with fractions that require factoring	26.7	30.0	30.0	13.3	30.0
Trigonometry					
Tangent ratio	46.7	26.7	46.7	53.3	3.3
Sine ratio	36.7	26.7	46.7	53.3	13.3
Cosine ratio	36.7	26.7	46.7	53.3	13.3
Cotangent ratio	16.7	23.3	46.7	53.3	20.0
Statistics					
Average	53.3	53.3	53.3	76.7	0.0
Arranging data	46.7	33.3	46.7	76.7	0.0
Median	33.3	33.3	53.3	76.7	0.0
Frequency	16.7	23.3	46.7	73.3	0.0
Mode	33.3	33.3	43.3	73.3	0.0
Sampling	20.0	23.3	46.7	73.3	0.0

high school general mathematics program. Of the nineteen topics on which there was not a majority agreement, six topics had a mean rating below 2.0 and in seven other instances 20 per cent or more of the appraisal group recommended that the topic be omitted.

It is further noted that there was a majority agreement in placing forty-one of the topics in more than one year of the high school program of general mathematics. This trend was also indicated by the following comments from six of the panel members:

(1) 9th: Emphasis on algebra with arithmetic approached through algebra as much as possible. I would prefer. . . a continual maintenance plan set up in an interesting fashion throughout the entire general mathematics program.

10th: Geometry emphasis but drawing on all areas whenever a topic is strengthened by doing so.

11th: Trigonometry emphasis but with same reservations as expressed above.

12th: Business practices at a higher level than in the ninth grade.

(3) The review of arithmetic which the weak students need is better taught, we think, in the process of doing some very simple algebra. These boys and girls are bored with arithmetic and need something new. In beginning algebra they begin to see more of the nature of mathematics, and the work can be so planned that they review their arithmetic without realizing it.

(4) I go along with H. Vernon Price of Iowa that we assume each year to be the last year that students might have mathematics. For that reason you hit everything every year.

(5) Many topics are introduced in the seventh and eighth grades, but they are taught more intensively and with

more mature approach in the ninth grade. Then although taught in the ninth, they must be reviewed in the following grades to increase understanding and to keep at functional level. So you have a somewhat spiral arrangement with increasing difficulty in each succeeding year.

(6) I believe in the effectiveness of spiral learning. For example, the concept of an "equation" may be initiated in a very early grade and this concept is nourished, extended, and enlarged through the work of many grades. . . A large number of these topics initiated in the ninth grade should also be included and extended in later years.

Indication of the scope of the high school general mathematics program was revealed by an examination of the overall placement of the 126 topics by individual members of the evaluating panel in which 3-1/3 per cent of the members indicated a one-year terminal course; 3-1/3 per cent a two-year program, 3-1/3 per cent a three-year program, 90 per cent a four-year sequence. Inauguration and maintenance of a program of so broad a scope present further problems as pointed out by one of the panel members in the following comment:

> Ideally, the non-college preparatory student should spend four years (grades 9-12) with the type material I have checked. Whether we can get administrators to see the need for this and find sufficient teachers I cannot say.

CHAPTER VI

A RECOMMENDED PROGRAM FOR HIGH SCHOOL GENERAL MATHEMATICS AND PROPOSALS FOR FURTHER STUDY

I. RECOMMENDED PROGRAM FOR HIGH SCHOOL GENERAL MATHEMATICS

Included in the recommended program presented here for high school general mathematics are all topics with mean rating as high as 2.0 which, in the original check list, was the point value assigned topics of some (i. e., unspecified but appreciable) importance. A topic is included in the content of each year in which a majority of the panel members agreed in placing the topic. For the thirteen topics having a mean rating higher than 2.0 on which a majority did not agree as to placement, each topic is included as supplementary material in the grade or grades in which there was the greatest per cent of agreement in placement.

In the following syllabus of the recommended program for high school general mathematics, topics are listed for each high school year in subject categories, topics within the categories being arranged in order of importance from highest to lowest. Topics initiated in a previous high school year are marked with an asterisk; supplementary topics are indicated as such; topics derived from additional topics listed by members of the evaluating panel are indicated as optional.

TOPICS TO BE INCLUDED EACH YEAR IN THE RECOMMENDED PROGRAM FOR HIGH SCHOOL GENERAL MATHEMATICS

Freshman Year

Arithmetic

Fundamental processes with integers
Writing per cents as decimals
Finding a per cent of a number
Fundamental processes with fractions
Reading and writing decimal fractions
Fundamental processes with decimals
Changing common fractions to decimals
Reading and writing integers
Equivalent fractions
Finding what per cent one number is of another
Graphical representation
Writing per cents as fractions
Finding what part one number is of another
Reducing fractions to lowest terms
Writing decimals as per cents
Finding per cent of increase or decrease
Rounding off numbers
Finding a number when a fractional part is known
Changing the form of fractions
Writing fractions as per cents
Denominate numbers
Changing decimals to common fractions
Scale drawing
Finding a number when a per cent of it is known
Ratio and proportion
Simple interest
Significant digits
Liquid and dry measure
English and metric systems
Aliquot parts
Taxation
Squares and square root
Insurance
Finding selling price
Profit and loss
Trade discount
History of mathematics

Geometry

Area of a square
Area of a rectangle
Area of a triangle having given the base and altitude
Volume of a cube
Volume of a rectangular solid
Measuring and drawing angles
Rule of Pythagoras
Volume of a cylinder
Area of a parallelogram
Kinds of angles
Area of a circle
Indirect measurement (supplementary)
Ratio and proportion
Area of a trapezoid
Sum of the angles of a triangle
Circumference of a circle
Perimeter of plane figures
Construction of perpendiculars
Construction of bisectors
Symmetry
Construction of triangles
Classification of triangles by angles
Construction of parallels
Classification of triangles by sides
Volume of a pyramid (supplementary)
Volume of a cone
Volume of a prism (supplementary)

Algebra

Mathematical symbols
Equations solved by addition, subtraction, multiplication, and division processes
Evaluating algebraic expressions
Fundamental processes with signed numbers
Graph of a formula
Fundamental processes with monomials
Writing formulas
Literal equations
Parentheses
Powers
Equations with fractional coefficients
Roots
Decimal equations
Fractional equations

Statistics

Average

Sophomore Year

Arithmetic

*Fundamental processes with integers
*Fundamental processes with fractions
*Graphical representation
*Reducing fractions to lowest terms
*Scale drawing
*Ratio and proportion
*Significant digits
*English and metric systems
*History of mathematics

Geometry

*Area of a square
*Area of a rectangle
*Area of a triangle having given the base and altitude
*Measuring and drawing angles
*Rule of Pythagoras
*Area of a circle
Ratio and proportion
Similar triangles
*Sum of the angles of a triangle
*Circumference of a circle
*Perimeter of plane figures
*Construction of bisectors
*Symmetry
Volume of a pyramid (supplementary)
*Volume of a cone
Angle relationship in parallel lines
Construction of tangents (supplementary)

Algebra

*Mathematical symbols
*Equations solved by addition, subtraction, multiplication, and division processes

*Topic has been introduced in a previous year

*Evaluating algebraic expressions
*Fundamental processes with signed numbers
*Graph of a formula
*Fundamental processes with monomials
*Writing formulas
*Literal equations
*Equations with fractional coefficients
*Decimal fractions
*Fractional equations
Curved line graphs (supplementary)
Fundamental processes with polynomials (supplementary)
Quadratic formula (supplementary)

Statistics

*Average

Junior Year

Arithmetic

*Fundamental processes with integers
*Graphical representation
*Ratio and proportion
*Significant digits
Personal and family budgets
*History of mathematics

Geometry

*Volume of a rectangular solid
Indirect measurement (supplementary)
*Ratio and proportion
Similar polygons
Volume of a sphere

Algebra

*Literal equations
*Fractional equations
Simultaneous equations
Direct variation
Curved line graphs (supplementary)
Inverse variation

*Topic has been introduced in a previous year.

Radicals (supplementary)
Quadratic equations solved by factoring (supplementary)
Factoring a quadratic trinomial (supplementary)
Factoring the difference of two squares (supplementary)
Factoring a perfect trinomial square (supplementary)
The three signs of a fraction (supplementary)

Statistics

*Average
Median

Senior Year

Arithmetic

*Fundamental processes with integers
*Graphical representation
*Simple interest
Borrowing money
Checking accounts
*Taxation
Savings and investments
Compound interest
Installment plan buying
*Insurance
Cost of owning and operating an automobile
*Personal and family budgets
Bills and accounts
*Finding selling price
*Profit and loss
Cost of owning or renting a home
Depreciation
Promissory notes
Purchase of food and clothing
Bank discount
*History of mathematics
Commission and brokerage

Trigonometry

Tangent ratio
Sine ratio
Cosine ratio

*Topic has been introduced in a previous year.

Statistics

*Average
Arranging data
*Median
Frequency
Mode
Sampling

Optional Topics

Arithmetic

Present value, i.e., $(1+i)^{-n}$
Amortization
Life insurance plans
Approximate numbers
Numeral systems other than decimal
Per cent of error
Estimating results

Geometry

Nature of definition
Inductive reasoning
Concepts of inverse, converse, contrapositive
Indirect proof
Euler's circles
Detection of logical fallacies
Deductive processes
Approximate nature of measurement
Angular measurement

Algebra

Concept of identity vs. equation
Number system
Power law
Exponential law
Complex numbers
Commutative, associative, distributive laws

Trigonometry

Angle of elevation and depression

*Topic has been introduced in a previous year.

Slide rule
Oblique triangle

Statistics

Index numbers
Harmonic average
Simple probability

The distribution of topics over a four-year period is in agreement with the planned sequence in general mathematics as advocated by Douglass[1] and with the recommendation of Breslich[2] that some mathematical instruction should be a part of each year's work of the high school program.

It is noted that the program for the freshman year includes a total of seventy-nine topics from four subject categories: thirty-seven from arithmetic, twenty-seven from geometry, fourteen from algebra, and one from statistics. The forty-one topics included in the sophomore year are drawn from the same four subject categories with eight new topics being introduced--five in geometry and three in algebra. Further decrease in the number of topics included in the program is noted in the junior year. However, fifteen of the twenty-five topics have not been introduced in a previous year. Of these fifteen new topics, one

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[1]Harl R. Douglass, ed., The High School Curriculum, (New York: The Ronald Press, 1956), p. 472.

[2]E. R. Breslich, "New Mathematical Courses," California Journal of Secondary Education, 22: 461, December, 1947.

is in arithmetic, three are in geometry; ten are in algebra; one is in statistics. The program for the senior year includes a total of thirty-one topics from three subject categories: twenty-two from arithmetic, three from trigonometry, and six from statistics. In arithmetic thirteen new topics are included; trigonometry makes initial appearance in the high school general mathematics program; in statistics four topics occur for the first time.

II. PROPOSALS FOR FURTHER STUDY

It is noted in the above program that the number of topics included each year decreases sharply after the freshman year, when a total of seventy-nine topics are included. This indicates a further problem concerning the allocation of time for the general mathematics program, particularly in the remaining three years. Further study of the problem is therefore recommended in order to determine (1) the amount of time to be allotted to the general mathematics program in each of the four high school years and (2) the measures involved in the organization and administration of such a high school general mathematics program.

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APPENDIX A

LOUISIANA STATE UNIVERSITY
College of Arts and Sciences
Baton Rouge 3, Louisiana

Department of Mathematics

I am conducting a study to determine the content of general mathematics courses and the placement of subject-matter topics in the high schools of the United States. These data are being obtained from the state department of education of each of the forty-eight states.

This investigation is concerned with those courses which deviate from the traditional, college preparatory sequence; it is concerned with those courses designed to serve the purpose stated by the Post-War Commission "to insure mathematical competence for the ordinary affairs of life". If the _____ State Department of Education includes such a program in the course of study, I am requesting you to participate in the completion of this study by filling out and returning the enclosed questionnaire which is designed to minimize the consumption of your time.

I am enclosing a stamped self-addressed envelope for your convenience.

Sincerely,

_____
Lois T. Wales
Instructor of Mathematics

enc
ltw/bdw

1. Is there a state supervisor of mathematics in your state?

   Yes____ No____

   (If answer is "yes", please give the name of the state

   supervisor of mathematics_____)

2. How many units in mathematics are required for high school

   graduation? _____

If one course in high school general mathematics is included in the state course of study, please supply the following information concerning that course.

1. Title of course:_____

2. Year offered: Freshman____Sophomore____Junior____

   Senior____Elective____

3. State-adopted or state-approved textbooks used:

Title	Author	Publisher
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

4. Is the course required for high school graduation?

   Yes____No____

If additional courses in general mathematics are included in the state course of study, please supply the following information concerning each of those courses:

1. Title of course: _____

2. Year offered: Freshman_____ Sophomore_____ Junior_____

   Senior_____ Elective_____

3. State-adopted or state approved textbooks used:

Title	Author	Publisher
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

4. Is the course required for high school graduation?

   Yes_____ No_____

****

1. Title of course: _____

2. Year offerred: Freshman_____ Sophomore_____ Junior_____

   Senior_____ Elective_____

3. State-adopted or state approved textbooks used:

Title	Author	Publisher
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

4. Is the course required for high school graduation?

Yes_____ No_____

****

1. Title of course:_____

2. Year offerred: Freshman_____ Sophomore_____ Junior_____

Senior_____ Elective_____

3. State-adopted or state approved textbooks used:

Title	Author	Publisher
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

4. Is the course required for high school graduation?

Yes_____ No_____

****

1. Title of course:_____

2. Year offerred: Freshman_____ Sophomore_____ Junior_____

Senior_____ Elective_____

3. State-adopted or state approved textbooks used:

Title	Author	Publisher
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

4. Is the course required for high school graduation?

Yes_____ No_____

APPENDIX B

I am conducting a study to determine the content of high school general mathematics courses and grade placement of topics. The content is to be determined by an analysis of textbooks now in use in these courses.

I am asking you to cooperate with me in this phase of the study by sending me for examination the textbooks listed below which you publish. It has been brought to my attention that you have complimentary copies available for purposes of advertising; however, if such copies are not available I want to assure you that all copies will be returned when the analysis is complete.

Very truly yours,

Lois T. Wales
P. O. Box 464
Franklinton, La.

TITLE	AUTHOR

APPENDIX C

TABLE XIII

REFERENCE NUMBERS USED TO DESIGNATE TITLES OF TEXTBOOKS IN TABLE XIV THROUGH TABLE XXXIII

Reference Number	Title	Author
1	Everyday General Mathematics Book I	Betz et al.
2	Everyday General Mathematics Book II	Betz et al.
3	General Mathematics	Edgerton and Carpenter
4	Functional Mathematics Book I	Gager et al.
5	Functional Mathematics Book II	Gager et al.
6	General Mathematics	Grossnickle
7	General Mathematics in Daily Activities	Hart and Gregory
8	Mathematics in Daily Use	Hart et al.
9	Basic Ideas of Mathematics	Lankford and Clark
10	Mathematics for the Consumer	Lankford et al.
11	The New Applied Mathematics	Lasley and Mudd
12	Practical Mathematics	Lennes
13	Economic Mathematics	Lennes and Sutton
14	General Mathematics	Mallory and Skeen
15	Mathematics for Today	Marino and Fawcett
16	Making Mathematics Work	Nelson and Grime
17	Everyday Problems in Mathematics	Nelson et al.
18	Going Places with Mathematics	Peters
19	Mathematics to Use	Potter et al.
20	Refresher Arithmetic and Practical Applications	Stein

TABLE XIV

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 1

Topic	Number of pages	Per cent of space
1. The place of mathematics in human affairs: development of mathematics	5	.9
2. Learning about important forms: common natural forms; standard forms of geometry; making designs	23	5.3
3. Making sure of fundamental processes with integers and fractions; computing with integers and fractions; solving everyday problems	50	11.5
4. Measuring lengths: scale drawings; areas and volumes	29	6.7
5. Making sure of fundamental processes with decimal fractions and denominate numbers	29	6.7
6. Graining a mastery of percentage: learning to use per cents; using fractional and decimal per cents; everyday problems in percentage	23	5.3
7. The language of graphs: making graphs of numerical records; gaining skill in using the graphic method	16	3.7
8. Budgeting and spending: use of money in personal and family affairs; buying wisely; recurring expenses	15	3.4
9. Banks: saving money; origin and importance of banks; using a savings or checking account; the lending service of a bank; promissory notes	23	5.3
10. Taxation; insurance; investments	25	5.7
11. Circles and angles: finding circumference; central angles; related facts and constructions	25	5.7
12. Triangles: basic constructions; parallel lines and mechanical drawing	25	5.7

TABLE XIV (continued)

Topic	Number of pages	Per cent of space
13. Making comparisons: ratio and proportion	21	4.8
14. Learning to use mathematical shorthand: how letters are used in algebra; similar terms; evaluating algebraic expressions; related values; fundamental operations	23	5.3
15. The formula: using area and volume formulas; making formulas based on verbal statements; using formulas in applied problems	27	6.2
16. Equations and problems	24	5.5
17. Indirect measurement and the hypotenuse rule: indirect measurement based on scale drawing; indirect measurement leading to trigonometry; the hypotenuse rule; square root	26	6.0

TABLE XV

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 2

Topic	Number of pages	Per cent of space
1. The meaning and uses of mathematics: applications	5	1.1
2. The formula: perimeter formulas and related processes; area and volume formulas	23	5.3
3. Equations and problems	24	5.5
4. Signed numbers	16	3.6
5. Fundamental operations: operations using monomials and polynomials; using algebraic fractions and ratios	38	8.7
6. Equations of first degree in one or two unknowns: ratio, proportion, and related problems	30	6.8
7. Mathematics in individual and community life: wise use of money; home ownership and related problems; insurance; taxation; investments	30	6.8
8. Using mathematics in technical work: applied problems of mensuration; accuracy in measurement	23	5.3
9. Science and mathematics in the world today: tools used in science and mathematics; learning about electricity; directions and vectors	26	5.9
10. Constructions: drawings and blueprints	19	4.3
11. Square root: the hypotenuse rule	14	3.2
12. Making figures the same or similar: congruence; similarity; discovering geometric truths; a glimpse of demonstrative geometry	27	6.2
13. Indirect measurement: similar triangles; trigonometry	21	4.8
14. Special products and factoring: fractions and fractional equations	24	5.5

TABLE XV (continued)

Topic	Number of pages	Per cent of space
15. Radicals and quadratic equations	22	5.0
16. Learning about aviation: role of aviation in the world today; maps and charts; basic flight problems	26	5.9
17. First steps in statistics: arranging statistical data; picturing frequency distribution; computing averages	19	4.3
18. Recalling basic geometric ideas, facts, and processes	13	3.0
19. Looking again at the fundamentals of arithmetic	8	1.8

TABLE XVI

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 3

Topic	Number of pages	Per cent of space
1. Graphs: bar graph; circle graph; broken-line graph; curved line graph; statistical graphs	33	6.7
2. Direct measurement and formulas: square measure; evaluating a formula; functions; variables	27	5.6
3. Formulas and equations: related numbers; writing formulas; graph of a formula; curved line graph; equations	36	7.3
4. Elementary geometry: basic constructions; axioms; theorems; congruent triangles; parallel lines; symmetry	26	5.3
5. The use of the equation: addition of polynomials; parentheses; solving equations; equations with fractional coefficients; literal equations	39	8.0
6. Applying equations to geometry: sum of the angles of a polygon; areas; volumes; practical applications	18	3.7
7. Negative numbers: fundamental operations	31	6.3
8. Polynomials with negative numbers: fundamental operations	32	6.5
9. Fractions and decimals: equations containing decimals; fractional equations	27	5.6
10. Ratio and proportion: scale drawing; trigonometry	30	6.1
11. Graphs of simple linear equations: systems of equations; algebraic solution of systems of equations	33	6.7
12. Powers, roots, and radicals	28	5.7

TABLE XVI (continued)

Topic	Number of pages	Per cent of space
13. Factoring, quadratic equations, variation: factoring quadratic trinomials, perfect trinomial squares, difference of two squares; application of factoring to fractions; change of signs in fractions; solving quadratic equations by factoring, formula, graph; direct and inverse variation	48	9.8
14. Problems of community life; census; taxes; interest; stocks and bonds; insurance; installment buying	41	8.4
15. Aerial navigation: latitude and longitude; bearing of a line; problems of pilots	18	3.7

TABLE XVII

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 4

Topic	Number of pages	Per cent of space
1. Using numbers in measurement: measurement of length; significant digits; scale drawings	33	7.6
2. Statistical tables and graphs: tabulating statistical facts; mode, median, mean; graphs of statistical facts; rounding off numbers	35	8.1
3. Mathematics in business: fractions and per cent; simple and compound interest; promissory notes; services rendered by banks; installment buying	45	10.1
4. Mathematics of insurance and taxation	25	5.8
5. Mathematics and geometric designs: kinds of angles; congruency; symmetry; similarity; related angles	47	10.8
6. Advantages of literal numbers: formulas; dependence as found in tables and graphs	32	7.4
7. Extending the number concept: fundamental operations with signed numbers; processes with monomials; symbols of grouping; fundamental rule of equations; problems solved by equations	55	12.7
8. Indirect measuring: similar triangles in measurement; the Pythagorean relation; squares and square root; scale drawing; tangent, sine, and cosine ratio	50	11.5
9. Efficient manipulation: fundamental processes with polynomials; factoring trinomials; factoring the difference of two squares; solving quadratic equations by factoring and by the quadratic formula; fractions requiring factoring; fractional equations	55	12.7
10. Using functional relationships: graphing a linear equation; solving sets of linear equations algebraically and graphically	52	12.0

TABLE XVIII

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 5

Topic	Number of pages	Per cent of space
1. Looking to the future: installment buying; insurance	48	10.7
2. Saving and investments: simple and compound interest; postal and bank savings; building and loan associations; stocks and bonds	56	12.5
3. Constructions and how we use them: construction of regular polygons; use of circles in design	26	5.8
4. Correct patterns of thinking: assumptions and deductive thinking; the If-Then form of thinking; corresponding parts of congruent triangles; converse statements; sum of the interior angles of a polygon	42	9.4
5. Relationship: picturing first-degree relationships; formulas from tables and graphs; graphic and algebraic solution of systems of first-degree equations	42	9.4
6. Quadratic equations; solving quadratic equations by factoring, by graph, and by the quadratic formula; squares and square root	56	12.5
7. Taxes: income tax; social security; excise tax	28	6.3
8. Measurement: significant digits; areas of plane figures; measurement of angles; volumes of solids	48	10.7
9. Comparison by use of proportion and similarity: ratio; direct and inverse proportion; similar polygons	36	8.1
10. Putting the right triangle to work: rule of Pythagoras; sine, cosine, tangent ratio	37	8.3
11. Checking up on mathematical abilities	13	2.9

TABLE XIX

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 6

Topic	Number of pages	Per cent of space
1. Fundamental processes with integers	20	5.5
2. Fundamental processes with fractions	20	5.5
3. Fundamental processes with decimals; metric units; denominate numbers; rounding off numbers	31	8.6
4. Percentage: expressing a fraction as per cent; finding a per cent of a number; what per cent one number is of another; finding a number when a per cent of it is given; household budgets; simple interest; installment buying	38	10.5
5. Reading and interpreting graphs	22	6.1
6. Savings and investments: compound interest; stocks and bonds	34	9.4
7. Insurance and taxation	26	7.2
8. Informal geometry and the formula: drawing angles; circle graphs; basic constructions; perpendicular and parallel lines; kinds of angles; kinds of triangles; congruent triangles; tangents; area of a rectangle, parallelogram, triangle, trapezoid, circle; volume of a prism, rectangular solid, cone, cylinder, pyramid; evaluating formulas	39	10.8
9. Equations: one-step equations; solving equations using two or more rules; problem solving; fundamental processes with signed numbers; parentheses; processes with monomials	36	9.9
10. Algebraic fractions with monomial denominators: fundamental operations; fractional equations; graphing simultaneous equations	31	8.6
11. Ratio and proportion: similar triangles; direct and inverse proportion	31	8.6
12. Indirect measurement: hypotenuse rule: squares and square roots; tangent and cotangent ratios; angles of elevation and depression	25	6.9

TABLE XX

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 7

Topic	Number of pages	Per cent of space
1. History and importance of mathematics	5	1.2
2. Scale drawings and graphs; rounding off numbers; bar, broken-line, and smooth-line graphs; pictographs	33	8.1
3. Statistics: arranging data in a table: mode, mean, median, interpretation of data	9	2.2
4. Practical geometry: measuring and drawing segments and angles; perpendiculars; parallels; area of a rectangle, circumference of a circle; volume of a rectangular solid	42	10.3
5. Formulas and equations: formulas for percentage and cost; equation solving	21	5.2
6. Home-life mathematics: personal and family accounts; installment buying; budgets; insurance; owning or renting a home; savings banks; interest	62	15.3
7. Leisure time problems: recreational statistics; standard time; railroad transportation; airplane and automobile travel	28	6.9
8. Elementary vocational mathematics: counting change; short cuts in multiplication; pay roll clerk; problems of agents; ratio and proportion	26	6.4
9. Community life mathematics: extent and cost of community services; taxation	30	7.4
10. Elementary business mathematics: invoices; trade discount; profit and loss; decimal equations; finding selling price; promissory notes	28	6.9
11. More mathematical tools: signed numbers; ratio and proportion; making and using formulas; perpendiculars; area of a triangle and trapezoid; similar polygons	40	9.9

TABLE XX (continued)

Topic	Number of pages	Per cent of space
12. More vocational problems; metric measure; directions in aviation; horsepower	14	3.4
13. Indirect measurement: rule of Pythagoras; tangent ratio	10	2.5
14. Fundamentals of arithmetic: fundamental processes with integers; common fractions and decimal fractions	34	8.4

TABLE XXI

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 8

Topic	Number of pages	Per cent of space
1. Integers; reading and writing integers; processes involving integers; denominate numbers; problems of home and school involving integers	45	12.0
2. Fractions: basic concepts; processes involving fractions; problems involving fractions	34	9.1
3. Decimals: reading and writing decimals, processes involving decimals; rounding off numbers	38	10.2
4. Measurement: units of length; finding perimeter, area, surface, volume; measuring weight, liquid, time; problems of measurement	45	12.0
5. Percentage: using per cents and fractional rates; problems involving per cents	33	8.8
6. Graphs: reading, drawing, and interpreting bar graphs, broken-line graphs, smooth-line graphs, and pictographs	22	5.9
7. Protecting family income; family budgets; selection and purchase of food and clothing; installment buying; cost of operating an automobile; cost of owning or renting a home; insurance	24	6.4
8. Community activities: sales, automobile, property, and income taxes; social security; problems involving community activities	22	5.9
9. Business activities: overhead; purchasing; profit and loss; selling price; banking practices; simple interest; promissory notes	28	7.5
10. Introduction to algebra: mathematical symbols; formulas; equations; signed numbers; problem-solving	36	9.6
11. Introduction to geometry: straight line-segments; angles; perpendiculars: parallels; triangles; scale drawing; hypotenuse rule	15	4.0

TABLE XXII

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 9

Topic	Number of pages	Per cent of space
1. Life in the midcentury: sports and science; whole numbers; rounding off numbers; fundamental operations with integers	41	8.1
2. Fractions in measurement: units of measure; changing the form of fractions; fundamental operations with fractions	38	7.5
3. Decimals in measurement: reading and writing decimals; fundamental operations with decimals; changing common fractions to decimals; metric system	34	6.7
4. On to geometry: measuring angles; kinds of angles; experiments with triangles	24	4.8
5. Construction and design: basic constructions; parallel lines; constructing a parallelogram; dividing a line into equal parts; making identical triangles; ratio	42	8.3
6. The use of per cent: finding a per cent of a number; changing per cents to decimals; changing decimals to per cents; discount and commission; per cent of increase or decrease; finding what per cent one number is of another; finding a whole when a per cent of it is known	40	7.9
7. Mathematics and daily living: budgets and accounts; insurance; social security; taxation; installment buying	34	6.7
8. Putting your savings to work: investing in a home; services of a bank; interest	26	5.2
9. How to picture number relations: bar, line, and circle graphs; pictograms; median	30	6.0
10. Introduction to algebra; relationships in measurement; similar terms; variation; graph of a relationship	28	5.6

TABLE XXII (continued)

Topic	Number of pages	Per cent of space
11. Putting algebra to work: stating, writing, and solving equations; using equations in problems; signed numbers	48	9.5
12. Formulas of geometry: the rule of Pythagoras; square root; area; surface volume	36	7.1
13. Measuring by means of triangles: similar triangles and indirect measurement; tangent, cosine, sine	34	6.7
14. Mathematics on the job: mathematics in nursing, farming, building, clerking	30	6.0

TABLE XXIII

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 10

Topic	Number of pages	Per cent of space
1. How to handle statistics: using simple statistics; collecting data; presenting data; averages; drawing conclusions from data	83	18.9
2. Better buymanship: saving money when buying food, clothing, and shelter; saving by paying bills promptly; operating an automobile; common units of measure	47	10.7
3. Using consumer credit: installment buying; borrowing from a small loan company; bank loans; credit unions; loan sharks	48	11.0
4. At home and on the job: the family budget; cost of utilities; discounts; bank statements; mathematics needed in a small business	46	10.5
5. Investments: stocks and bonds; reading and interpreting financial news; simple and compound interest	43	9.8
6. Greater security: insurance; social security	50	11.4
7. Taxation: kinds and sources of taxes: income tax; sales tax; property tax; automobile taxes; custom duties; social security	47	10.7
8. Computation: changing fractions and decimals to per cents; changing per cents to fractions and decimals; finding a per cent of a number; finding per cents greater than 100% and less than 1%; finding what per cent one number is of another; per cent of increase or decrease; fundamental operations with integers, fractions, and decimals	52	11.9

TABLE XXIV

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 11

Topic	Number of pages	Per cent of space
1. History and importance of mathematics	6	1.6
2. Fundamental processes with integers	23	6.0
3. Fundamental processes with fractions	18	4.7
4. Fundamental processes with decimals	21	5.4
5. Percentage and problem solving: Percentage problems; finding a per cent of a number; finding what per cent one number is of another; finding a number when a certain per cent of it is known	19	4.9
6. Denominate numbers: ratio and proportion	19	4.9
7. Direct measurement of lines and angles: measuring lines and angles directly; metric system; scale drawing; kinds of angles	22	5.7
8. Graphs: bar, line, circle graphs; pictographs	24	6.2
9. Insurance: life, health, accident, insurance; workman's compensation; fire and automobile insurance	17	4.4
10. Banks, savings, and investments: simple and compound interest; stocks and bonds; checking and savings accounts	28	7.2
11. Problems of the consumer: budgets; cash record; consumer buying and borrowing; credit buying; renting or owning a home; depreciation	31	8.0
12. Local, state, and federal taxes: property tax; sales tax; income tax; import duties; excise tax; special taxes	14	3.6
13. Position and form of objects: parallels; perpendiculars; places on a map; plane and solid figures	18	4.7
14. Size of plane and solid figures: perimeter; area of a rectangle, square, parallelogram, triangle, trapezoid, circle; volume of a rectangular solid, prism, cylinder, cone, pyramid	32	8.3

TABLE XXIV (continued)

Topic	Number of pages	Per cent of space
15. Constructions: kinds of triangles; sum of the angles of a triangle; perpendiculars; bisecting a line and an angle	7	1.8
16. Indirect measurement: square root	8	2.1
17. The formula: writing formulas; similar terms; evaluating and graphing formulas	19	4.9
18. The equation: solving equations; problems using equations	15	3.9
19. Signed numbers: processes using signed numbers; graphing signed numbers	14	3.6

TABLE XXV

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 12

Topic	Number of pages	Per cent of space
1. Whole numbers and decimals: fundamental processes	26	6.5
2. Common fractions: fundamental operations	12	3.0
3. Equations	12	3.0
4. Percentage: simple applications	36	9.0
5. Graphs: bar, circle, line graphs, pictographs	16	4.0
6. Measuring: area of a rectangle, trapezoid, circle; volume of a rectangular solid, cylinder, pyramid, cone, sphere; square root; kinds of triangles; area of a triangle having given the sides	33	8.2
7. Cost of owning a car	10	2.5
8. Cost of owning a house	8	2.0
9. Insurance: life insurance; automobile insurance	12	3.0
10. Taxes: tax rate; local, state, and federal taxes	10	2.5
11. Miscellaneous home problems: sales slips, checks and receipts; reading meters	10	2.5
12. Buying, preparing, and serving food	20	5.0
13. Household accounting; uses of family accounts	12	3.0
14. Buying lumber: board feet; length of rafters	8	2.0
15. Excavating: cement work: pouring concrete; lining a cistern; building a silo	10	2.5
16. Useful geometric figures: drawing parallels; dividing a line into equal parts; triangles; hexagon	16	4.0
17. Symmetrical figures: point and line symmetry	6	1.5
18. Simple technical problems: indirect measurement	8	2.0

TABLE XXV (continued)

Topic	Number of pages	Per cent of space
19. Installment buying: rate of interest; automobile financing	12	3.0
20. Farm problems: farm inventories and accounts	20	5.0
21. Large numbers and their uses: computing with large numbers; rounding off numbers	6	1.5
22. The grade curve; distribution of data; probability	20	5.0
23. The march of progress: rural and urban population; school attendance; women in industry; production; construction	60	15.0

TABLE XXVI

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 13

Topic	Number of pages	Per cent of space
1. Counting numbers	6	1.1
2. Fundamental processes with integers	52	9.7
3. Divisibility of numbers: factors; multiples; cancellation	11	1.9
4. Fundamental operations with fractions	23	4.3
5. Decimals: reducing fractions to decimals	22	4.1
6. Aliquot parts	7	1.3
7. Bills and accounts	10	1.9
8. Denominate numbers	28	5.2
9. Ratio and proportion	8	1.5
10. Square roots; mensuration; specific gravity	52	9.7
11. Percentage: profit and loss; discounts; commission and brokerage; simple and compound interest; promissory notes	103	19.1
12. Partial payments: installment buying	12	2.2
13. Banks and bank discount	8	1.5
14. Bank balance: savings accounts	6	1.1
15. Stocks and securities: bonds; stock exchange	18	3.3
16. Graphic representation	9	1.7
17. Domestic and foreign exchange	16	3.0
18. Equation of payments and accounts	6	1.1
19. Property and fire insurance	17	3.2
20. Direct taxation: income tax; United States customs	15	2.8
21. Partnership	6	1.1
22. Storage	3	.6
23. Building and loan associations	4	.7
24. Depreciation	3	.6

TABLE XXVII

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 14

Topic	Number of pages	Per cent of space
1. Introduction: Development of our number system	6	1.3
2. Everyday uses of mathematics: mathematics in the home, at school, and on the job	19	4.0
3. Using fractions: processes with fractions; rounding off fractions	26	5.4
4. Using decimal fractions: fundamental processes with decimals; ratio	33	6.9
5. How we use per cent: changing fractions to per cent; changing decimals to per cent; changing per cents to decimals and common fractions; finding what per cent one number is of another; finding a per cent of a number; baseball averages	29	6.1
6. Reading graphs	21	4.4
7. Drawing graphs: bar and line graphs; graph of a formula	21	4.4
8. The family budget: housing expenses; savings	34	7.1
9. Government and banking; cost of government; taxes; checking and savings accounts	29	6.1
10. Money will work for you: simple and compound interest; insurance	31	6.5
11. Measurement in everyday affairs: circumference of a circle; metric units; measuring areas, angles, and lines	43	9.0
12. Solving problems by drawings: scale drawings; similar triangles; constructing triangles	31	6.5
13. Everyday geometry: bisectors; perpendiculars; parallels; circles and circle graphs; test for right triangles	39	8.2
14. Uses of algebra: simple terms; formulas; parentheses; equations	33	6.9

TABLE XXVII (continued)

Topic	Number of pages	Per cent of space
15. Areas and volumes: areas of a rectangle, parallelogram, triangle, trapezoid circle; volume and surface of a box and cylinder	28	5.9
16. A new kind of measurement: the right triangle rule; tangent ratio; proportion; similar triangles	22	4.6
17. Practice in computation	21	4.4

TABLE XXVIII

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 15

Topic	Number of pages	Per cent of space
1. The importance of being accurate: fundamental operations; common fractions; decimals; problems involving several operations; proportion; per cent	42	8.4
2. Mathematics at home: personal and family budgets; bank accounts; savings; interest	37	7.4
3. Some common-sense arithmetic; buying; bills; home measurement; cost of utilities; buying or renting a house	36	7.2
4. From business to baseball with per cent: trade discount; discount series; profit and loss; commission and brokerage; baseball and per cent	41	8.2
5. Borrowing: cash vs. credit; installment buying; secured and unsecured loans; cost of buying a home	36	7.2
6. Arithmetic on wheels and wings; buying a car; operating a car; buying and flying an airplane	30	6.0
7. Understanding statistics: arranging data; frequency; average, median, mode; sampling	34	6.7
8. Making ideas visible: bar and line graphs; index numbers; pie charts and pictographs	44	8.5
9. Spreading the risks: property insurance; theft and liability insurance; automobile insurance	34	6.7
10. The most valuable thing you own: term and ordinary life insurance; endowments and annuities; sickness and accident insurance	38	7.6
11. Social security: retirement funds; survivors insurance; employment security	26	5.2
12. Paying taxes: excise, property, and income taxes	42	8.4

TABLE XXVIII (continued)

Topic	Number of pages	Per cent of space
13. Seeking the unknown: equations; signed numbers; formulas	24	4.8
14. More about measuring: area and volume; geometric construction; scale drawings; putting triangles to work	39	7.8

TABLE XXIX

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 16

Topic	Number of pages	Per cent of space
1. Analyzing problems: estimating answers; steps in solving problems	27	4.2
2. Understanding whole numbers: processes with whole numbers; rounding off whole numbers	39	6.0
3. Understanding common fractions: fundamental processes	33	5.1
4. Understanding decimals: fundamental processes; expressing common fractions as decimals	28	4.3
5. Understanding per cents: multiplying and dividing by per cents; using per cents to compare numbers	11	1.7
6. Earning money: regular jobs for students; how workers are paid; average wages and rates	34	5.3
7. Accounts and budgets	36	5.6
8. Spending wisely: buying by mail; installment buying	36	5.6
9. Household bills: sales slips and charge accounts; bills for household utilities	34	5.3
10. Checks and money orders: using a checking account; sending and carrying money safely	28	4.3
11. Investing money wisely: bank accounts; letting the government use your money; associations for saving and lending money	30	4.7
12. Insurance for security: life insurance; insurance in accident and illness; social security	40	6.2
13. Borrowing money: banks and insurance companies	22	3.4
14. Owning your home: cost of shelter; buying a home	20	3.1

TABLE XXIX (continued)

Topic	Number of pages	Per cent of space
15. Going places: Cost of an automobile; public transportation	34	5.3
16. What your taxes buy: government income and expenditure; income tax	28	4.3
17. Statistics: statistical tables; graphs; describing data; how to use statistics	36	5.6
18. Geometry: measuring lines: making geometric constructions; finding areas, volumes, and surfaces	50	7.8
19. Algebra: equations; formulas; graphs of formulas; equations containing ratios	48	7.4

TABLE XXX

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 17

Topic	Number of pages	Per cent of space
1. Earning and spending money: making a budget; per cent of increase or decrease	22	4.4
2. Young workers' budgets: individual budgets	20	4.0
3. The family budget: problems in savings, insurance, rent, food and clothing	31	6.3
4. Household expenses: bills for utilities	35	7.1
5. Paying bills: cash payments; credit buying; installment buying	29	5.9
6. Methods of paying money: checking accounts; service charges; certified checks; bank drafts	14	2.8
7. The automobile: cost of operating and buying an automobile; automobile insurance	32	6.5
8. Shelter: paying off loans; bank loans; taxes; insurance; upkeep	35	7.1
9. Savings: postal savings; savings bonds; savings banks; savings accounts; credit unions; savings and loan associations	29	5.9
10. Life insurance: policies for ordinary life; twenty-payment, endowment, and term policies; health and accident insurance; social security	58	11.7
11. Borrowing money: real estate as security; stocks and bonds as security; life insurance as security; rates of interest	33	6.7
12. Taxes: city, county, state, and federal taxes	37	7.5
13. Wages: trained workers; medium incomes; wage-hour law	33	6.7
14. Travel: railroad, bus, and plane travel	24	4.9
15. Postal and telegraph service: parcel post; telegraphy; money orders; cables	23	4.7
16. Practical measurement: scale drawing, geometric figures; measuring land; volumes of prisms; cylinders, cones, pyramids, spheres; measuring lumber	39	7.9

TABLE XXXI

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 18

Topic	Number of pages	Per cent of space
1. Measuring with a ruler: adding and subtracting ruler fractions	14	3.9
2. Reducing fractions: multiplying fractions; improper fractions	24	6.7
3. Drawing to scale: division with mixed numbers	14	3.9
4. What are decimal fractions; reading and writing decimals; processes with decimals	39	10.9
5. Writing and using formulas: tables and formulas; perimeter formulas	20	5.6
6. Solving equations: using equations to solve problems	21	5.9
7. The meaning of per cent; writing per cents as decimals; writing per cents as fractions; finding a per cent or a number; using per cent in solving problems; writing decimals as per cents; writing fractions as per cents; finding a number when a per cent of it is known; percentage and sports; using per cent in a formula	37	10.3
8. How time zones work: earning money; keeping track of money; family budgets; buying wisely; how banks help	27	7.5
9. The compass and direction: more exact directions; the angle; the protractor; measuring direction by degrees	19	5.3
10. Plane and solid figures; areas and volumes	25	7.0
11. Ratio and proportion; using proportion in indirect measurement; the rule of Pythagoras; tangent ratio	26	7.2
12. Reading and making tables; statistics; graphs	36	10.1
13. Processes with integers	17	4.4

TABLE XXXII

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 19

Topic	Number of pages	Per cent of space
1. Circles; whole numbers: processes with integers; tangent circles; circumference and perimeters	63	12.5
2. Angles; common fractions: processes with fractions; measuring and constructing angles; bisecting angles; the sum of the angles of a triangle	78	15.5
3. Lines; decimal fractions: bisecting a line; perpendiculars; parallels; constructing tangents; adding and subtracting decimals; changing decimals to common fractions; changing fractions to decimals	46	9.2
4. Triangles; more decimal fractions: multiplying and dividing decimals; kinds of triangles; constructing triangles	48	9.6
5. Percentage: changing fractions to per cents; changing per cents to common fractions; finding a per cent of a number; interest; budgets; discount; commission; finding what per cent one number is of another; finding a whole when a per cent of it is known; borrowing money	50	9.9
6. A little algebra: fundamental operations; equations; formulas	58	11.6
7. Ratio and proportion; graphs; scale drawings; insurance	50	9.9
8. Perimeters; areas; volumes; latitude and longitude	41	8.2
9. Appendix: statistics; signed numbers; surface of a solid; formulas of electriicity; lumber measure; machines	26	5.2

TABLE XXXIII

NUMBER AND PER CENT OF PAGES DEVOTED TO VARIOUS TOPICS IN TEXTBOOK NUMBER 20

Topic	Number of pages	Per cent of space
1. Whole numbers: rounding off whole numbers; fundamental operations with integers	44	11.3
2. Common fractions: reducing to lowest terms; equivalent fractions; processes with fractions; finding the whole when a fractional part is known	54	13.9
3. Decimal fractions: reading and writing decimals; operations with decimals; short methods	62	16.0
4. Per cents: changing per cents to decimals; changing decimals to per cents; changing per cents to fractions; changing fractions to per cents; finding a per cent of a number; finding what per cent one number is of another; finding the whole when a per cent of it is known	28	7.2
5. Squares and square roots	12	3.1
6. Measure of length: bar and line graphs; rule of Pythagoras; similar triangles	23	5.9
7. Measuring area: area of a rectangle, square, parallelogram, triangle, trapezoid, circle	10	2.6
8. Measuring volume: volume of a rectangular solid, cube, cylinder, sphere, cone, pyramid	6	1.5
9. Capacity; liquid and dry measure; measure of weight	16	4.1
10. Measure of time; income; real estate; interest	15	3.9
11. Conversions of volume, capacity, and weight: English and metric systems; tip and rim speed	57	14.7

TABLE XXXIII (continued)

Topic	Number of pages	Per cent of space
12. Measure of angles and arcs: measuring and drawing angles; navigation; construction of triangles, regular polygons, bisectors, and perpendiculars; complementary, supplementary, and vertical angles; parallel lines and angle relationship; circle graphs; use of the mil; longitude and latitude	36	9.3

APPENDIX D

You have been recommended as a member of a panel considered qualified to evaluate courses in high school general mathematics. Following, you will find a list of topics which has been compiled from an analysis of twenty general mathematics textbooks currently used in high schools of the United States. You are requested to evaluate these topics relative to their importance and grade placement in a high school program of general mathematics using the following rating scale for importance:

4--Topic is essential
3--Topic is highly important
2--Topic is of some importance
1--Topic is of doubtful importance
0--Topic should be omitted

You are also requested to indicate the grade level (or levels) at which each topic should be included in the general mathematics program. Space has been left on the last page for your subjective opinion concerning the organization of the general mathematics program and the amount of time devoted to the program to insure mathematicsl competence for daily living.

For the purpose of this study general mathematics is defined as a course which (1) draws its materials from various mathematical subjects, (2) is designed for the large portion of the high school population which has neither the ability or need for the traditional college-preparatory sequence in mathematics, and (3) aims to prepare the individual to deal with quantitative problems he will encounter in his personal, family, and community affairs.

Your cooperation in the final phase of this study is greatly appreciated.

Sincerely,

Lois T. Wales
P. O. Box 464
Franklinton, Louisiana

COMBINED LIST OF TOPICS

Arithmetic	Importance of Topic Check One According to the Rating On Page 1					Placement of Topic Check One or More 1—Freshman Year 2—Sophomore 3—Junior 4—Senior 0—Omit				
	4	3	2	1	0	1	2	3	4	0
1. History of mathematics										
2. Fundamental processes with integers										
3. Rounding off numbers										
4. Reading and writing integers										
5. Denominate numbers										
6. Fundamental processes with fractions										
7. Reducing fractions to lowest terms										
8. Equivalent fractions										
9. Finding a number when a fractional part is known										
10. Finding what part one number is of another										
11. Changing the form of fractions										
12. Aliquot parts										
13. Reading and writing decimal fractions										
14. Changing common fractions to decimals										
15. Fundamental processes with decimals										
16. Changing decimals to common fractions										
17. Significant digits										
18. Writing percents as decimals										
19. Writing percents as fractions										
20. Finding a percent of a number										
21. Writing decimals as percents										
22. Writing fractions as percents										
23. Finding a number when a percent of it is known										
24. Finding what percent one number is of another										
25. Finding percent of increase or decrease										
26. Personal and family budgets										
27. Checking accounts										
28. Purchase of food and clothing										
29. Installment plan buying										
30. Cost of owning and operating an automobile										
31. Cost of owning or renting a home										
32. Savings and investments										
33. Bills and accounts										
34. Simple interest										
35. Compound interest										
36. Postal and telegraph service										
37. Public transportation										
38. Borrowing money										
39. Bank discount										
40. Promissory notes										
41. Taxation										
42. Insurance										

	Importance of Topic					Placement of Topic				
	4	3	2	1	0	1	2	3	4	0
43. Finding selling price										
44. Trade discount										
45. Profit and loss										
46. Depreciation										
47. Commission and brokerage										
48. Ratio and proportion										
49. Graphical representation										
50. Scale drawing										
51. Squares and square root										
52. Liquid and dry measure										
53. English and metric systems										
54. Tip and rim speed										
Will you indicate any additional topics which you consider necessary?										
Geometry										
55. Measuring and drawing angles										
56. Kinds of angles										
57. Construction of perpendiculars										
58. Construction of bisectors										
59. Construction of parallels										
60. Construction of tangents										
61. Construction of triangles										
62. Angle relationship in parallel lines										
63. Classification of triangles by sides										
64. Classification of tringles by angles										
65. Sum of the angles of a triangle										
66. Sum of the angles of a polygon										
67. Circumference of a circle										
68. Perimeter of plane figures										
69. Area of a rectangle										
70. Area of a square										
71. Area of a trapezoid										
72. Area of a circle										
73. Area of a triangle having given the base and altitude										
74. Area of a triangle having given the three sides										
75. Area of a parallelogram										
76. Volume of a rectanglar solid										
77. Volume of a cylinder										
78. Volume of a pyramid										
79. Volume of a cone										
80. Volume of a sphere										
81. Volume of a cube										
82. Volume of a prism										
83. Symmetry										
84. Indirect measurement										
85. Similar triangles										
86. Similar polygons										

	Importance of Topic					Placement of Topic				
	4	3	2	1	0	1	2	3	4	0
87. Use of the mil										
88. Ratio and proportion										
89. Rule of Pythagoras										
Will you indicate any additional topics which you consider necessary?										
Algebra										
90. Mathematical symbols										
91. Equations solved by addition, subtraction, multiplication, and division processes										
92. Equations with fractional coefficients										
93. Decimal equations										
94. Literal equations										
95. Fractional equations										
96. Quadratic equations solved by factoring										
97. Quadratic formula										
98. Curved line graphs										
99. Simultaneous equations										
100. Parentheses										
101. Writing formulas										
102. Graph of a formula										
103. Evaluating algebraic expressions										
104. Fundamental processes with signed numbers										
105. Fundamental processes with monomials										
106. Fundamental processes with polynomials										
107. Factoring a quadratic trinomial										
108. Factoring a perfect trinomial square										
109. Factoring the difference of two squares										
110. Working with fractions that require factoring										
111. The three signs of a fraction										
112. Powers										
113. Roots										
114. Radicals										
115. Direct variation										
116. Inverse variation										
Will you indicate any additional topics which you consider necessary?										
Trigonometry										
117. Tangent ratio										
118. Sine ratio										
119. Cotangent ratio										

	Importance of Topic					Placement of Topic				
	4	3	2	1	0	1	2	3	4	0
120. Cosine ratio										
Will you indicate any additional topics which you consider necessary?										
Statistics										
121. Sampling										
122. Frequency										
123. Average										
124. Mode										
125. Median										
126. Arranging data										
Will you indicate any additional topics which you consider necessary?										

Subjective comment:

VITA

The writer, Lois Tyler Wales, was born October 17, 1914 at Pineville, Louisiana. She received her elementary and high-school education in various schools of Louisiana and Mississippi, being graduated in 1932 from the Amite High School at Amite, Louisiana.

She received a Bachelor of Arts degree from Southeastern Louisiana College at Hammond, Louisiana in 1942 and a Master of Arts degree from Louisiana State University at Baton Rouge, Louisiana in 1952. For the past sixteen years the writer has been employed as mathematics teacher in the Franklinton High School with the exception of the session 1956-57 and the following summer when she served as instructor in the Mathematics Department at Louisiana State University. She is now a candidate for the degree of Doctor of Philosophy at Louisiana State University.

EXAMINATION AND THESIS REPORT

Candidate: Mrs. Lois E. Wales

Major Field: Education

Title of Thesis: A Recommended Program for High School Mathematics as Determined by an Appraisal of Present Content and Placement of Subject Matter

Approved:

W. A. Lawrence
Major Professor and Chairman

Richard J. Russell
Dean of the Graduate School

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Date of Examination:

May 8, 1958